Investigation of Landfill Impact on Groundwater Quality

Syosset and New Hyde Park Landfills

516-535-3314

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SYOSSET AND NEW HYDE PARK LANDFILLS

Submitted To:

Nassau County Department of Health
Mineola, New York

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January 7, 1983

ACKNOWLEDGEMENTS

ERM-Northeast gratefully acknowledges the assistance provided by the Nassau County Department of Health. We particularly appreciate the technical direction, advice and review provided by the following members of the Division of Environmental Health.

Frank Padar, P.E., Deputy Commissioner, Nassau County Department of Health

Sheldon Smith, P.E., Deputy Director, Division of Environmental Health

Mike Alarcon, P.E., Director, Bureau of Public Water Supply

Rick Liebe, Public Health Engineer, Nassau County Department of Health

Don Myott, P.E., Chief, Office of Groundwater Management

Stan Juczak P.E., Director, Bureau of Land Resources Management

Jim Adamski, Director, Environmental Health Laboratory

Appreciation is also expressed to James Gildersleeve, Division of Sanitation, Town of Oyster Bay and Bill Cook, Division of Sanitation, Town of North Hempstead for their historical description of landfill operations.

A special acknowledgement is made to Kevin Phillips, P.E., Ph.D. and the staff of Fanning and Phillips for their contribution to this report.

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SECTION 1.0

INTRODUCTION

1.1 Objectives

ERM-Northeast was retained in October, 1981, by the Nassau County Department of Health to conduct groundwater investigations at two closed municipal landfills in Nassau County. This project was funded by a grant from the New York State Department of Health.

The two sites selected by NCDH to be investigated were the Syosset landfill in the Town of Oyster Bay and the Denton Avenue landfill in New Hyde Park, Town of North Hempstead. Both sites were owned and operated by their respective Towns during the 1950's and 1960's, and subsequently closed. The general purpose of this project was to determine the existence, magnitude and quality of leachate plumes being generated at both sites.

To develop the site-specific objectives for each drilling and sampling program, all available water quality and hydrogeologic data were reviewed. Thick unsaturated zones at each site (100 feet at Syosset, 70 feet at Denton Avenue) and the amount of project resources available for well drilling were important considerations that also determined the scope of the field programs. The objectives for each site are described below:

Syosset Landfill

- Define the local configuration of the water table, the location of the regional groundwater divide with respect to the landfill and the direction and rate of groundwater flow. This was a primary objective at Syosset because the direction of groundwater flow was not precisely known prior to start of drilling.

- Establish groundwater quality beneath the site and determine if leachate is being generated. A previously published report from the 208 Study found minimal leachate impacts.

- Provide permanent monitoring wells that can be used to evaluate long-term groundwater quality trends.

- Determine if industrial waste that was reportedly accepted at Syosset is currently impacting groundwater quality.

- Evaluate the potential for leachate impacts on public water supply wells.

Based on reports indicating that the Syosset landfill was extensively used as an industrial waste disposal site, it was mutually agreed upon by NCDH and ERM-Northeast to commit a larger share of the drilling budget to this site.

Denton Avenue Landfill

- Define the local groundwater gradient in more detail, including water table modifications associated with the large recharge basin, that separates the north and south sections.

- Assess groundwater quality on the downgradient boundary of each landfill site and determine if leachate is currently impacting the upper glacial aquifer.

- Install permanent observation wells that can be used to monitor changes in groundwater quality over time.

- Evaluate the potential for leachate impacts on public water supply wells.

1.2 Report Organization

The Syosset and Denton Avenue landfills are discussed independently. The following organizational format is used for each:

Background - The location and current conditions of each site is described. The operational history and type of wastes disposed of are reviewed. Previous field work, if conducted, is summarized.

Installation of Monitoring Wells - The installation of the monitoring wells is described, the procedures followed in performing the field work are detailed, and the geologic and hydrogeologic setting of each site is discussed.

Sampling Procedures and Analytical Results - The collection of groundwater samples is discussed and the analytical results presented.

Discussion of Results - The laboratory analyses are discussed and interpreted in conjunction with collected hydrogeologic data.

Conclusions and Recommendations - The major conclusions are summarized and recommendations concerning remedial measures and additional field work are presented.

SECTION 2.0

BACKGROUND

2.1 Site Description

The Syosset landfill is a 44 acre roughly rectangular site located in the Town of Oyster Bay between Locust Grove and Jericho. The landfill is bounded by the Long Island Expressway and Miller Place to the south, the Long Island Railroad to the northwest and the Cerro Wire and Cable Company plant to the southeast. Single family residences and an elementary school border the site to the north and northeast. Offices and storage yards for the Town of Oyster Bay Sanitation and Highway Departments occupy the south end of the site along Miller Place.

Topographic relief at the site is minimal due to final grading of the refuse and installation of permanent landfill cover. Piles of demolition material, wood chips and residential yard debris (leaves) that have been recently dumped at the back of the site are responsible for slight surface undulations. Maximum and minimum surface elevations are found near the old incinerator which is currently used for the production and storage of road signs.

2.2 History of Site

Refuse disposal at the Syosset landfill reportedly began in 1940 and continued until 1975. Until 1967, there were no restrictions on the type of wastes accepted including residential, commercial, industrial, demolition, agricultural, scavenger (sludge) and ashes. After 1967, the Town of Oyster Bay opened the Old Bethpage landfill and only industrial waste and scavenger wastes were accepted until the site was closed in early 1975.

Only minimal written records are available describing operational procedures at the site. Interviews with Sanitation Department personnel who were involved with daily site activity have been the sole source of information on landfilling practices at the site. According to J. Gildersleeve (personal communication, August, 1982) the site was generally excavated to about 65 feet below grade and backfilled with garbage. There was little or no segregation of waste except for a scavenger waste pit that was southeast of the incinerator. The site was reportedly excavated and filled to within approximately 20 feet of the current fence line. The southern limit of refuse disposal is shown on Figure 3-2.

Gildersleeve has also described underground burning operations that occurred at the site. Covered refuse was apparently ignited and allowed to burn unchecked for extended periods. Combustible refuse and methane produced by refuse decomposition apparently provided fuel for the fire. Fires reportedly burned in at least one section of the landfill for a continuous period of about three years, with the exhaustion of fuel being responsible for it eventually extinguishing itself.

A limited inventory of industrial compounds dumped at the site can be compiled from industrial sludge analyses conducted by NCDH and an internal Hooker Chemical Company memo summarizing waste disposal at Syosset from 1946 to 1968. Table 2-1 presents the analytical results from sludge samples collected at the Syosset landfill in the fall and winter of 1974, prior to closure of the site. The industrial source of the sludge is identified where possible.

The Hooker Chemical Company memo discusses waste quantities as well as waste types. The annual volume of Hooker waste entering the Syosset landfill during the period 1955 to 1968 was described as being higher than during the initial period of waste disposal. The maximum volume cited by the memo was 800,000 lbs./year. Waste type is described as "any and all solid and liquid waste." A partial list of Hooker wastes identified in the memo is shown below:

alcohols	waste filter cake (mixture of celite, decolorizing carbon, spent toluene, solfonic acid catalyst, bicarbonate, trimellitate plasticize)
glycols	
perchloroethylene	
latex waste	
alum	
PVC sludge	polyvinyl chloride
PVC floor scrapings	vinyl chloride
vinyl chloride recovery still bottom	vinyl acetate
	trichloroethylene
spent lub oils	barium soap stabilizers
PCB therminal waste	cadmium soap stabilizers

To estimate the annual quantity of leachate produced at the Syosset landfill, the Thornthwaite water balance method (Thornthwaite and Mather, 1957) can be used. This procedure is based on the relationship between precipitation, evapotranspiration, runoff and soil moisture storage and can be expressed by the equation:

$$I = (P - Ro) - SMS - ET$$

Table 2-1

INDUSTRIAL SLUDGE ANALYSES

SYOSSET LANDFILL

CONSTITUENT	CERRO WIRE	COLUMBIA CORRUGATED CONTAINER (Dried Sample)	RANDOM SAMPLES			
			#1	#2	#3	#4
% Moisture	20.3%	--	23.9%	51.0%	68.0%	32.3%
% Volatiles	79.7%	--	26.9%	27.0%	26.4%	33.1%
% Solids	17.9%	--	76.1%	49.0%	32.0%	67.7%
Iron	45,000	265	41,000	69,000	73,750	71,500
Copper	32,000	59.4	45,750	17,600	44,500	27,400
Zinc	95,000	88.8	90,000	130,000	105,000	105,000
Lead	1,800	277	3,190	3,885	3,830	7,260
Cadmium	5.5	0.58	6.40	6.35	10.75	8.05
Chromium(Total)	212.5	42.1	335	225	225	295
Nickel	35.0	2.3	45.5	46.0	51.0	52.0
Titanium		115				
Manganese		1.15				
Magnesium		19.6				

All samples expressed as mg./kg.

where,

I = Infiltration

P = Precipitation

Ro = Runoff

SMS = Soil Mositure Storage

ET = Evapotranspiration

The assumptions used to quantify leachate generation both during operation and after closure are listed below.

- Annual average precipitation is 43.7 inches.
- Runoff during operation and after closure is zero. During operation the site was an excavated pit which would not produce runoff and currently the site's surface is somewhat bowl-shaped with drainage generally inward.
- Soil moisture retention depth was estimated to be 4.0 inches/yr.
- Evapotranspiration after closure, when vegetation was reestablished on top of the final cover was calculated to be 26 to 27 inches per year. During operation when vegetation cover was minimal, evapotranspiration is estimated to be 10% of the normal rate or approximately 3 inches per year.

Using these assumptions, it was calculated that during operations the recharge rate at the Syosset landfill was 41 inches per year. This equals an annual leachate generation rate of approximately 49,030,000 gallons (134,300 gpd) for the 44 acre site.

The volume of recharge generated after closure must be evaluated on a monthly basis because of seasonal variations in evapotranspiration and soil moisture storage. During the summer months when evapotranspiration is high, a soil moisture deficit develops that must be overcome before effective recharge can take place. Average monthly water balance calculations at Syosset show that no recharge occurs from June to September. A tabulation of monthly recharge values from the Syosset landfill after site closure shows an annual recharge rate of approximately 17.5 inches. This equals an annual recharge rate of 20,930,000 gallons (57,350 gpd). Appendix B contains the monthly post-closure water balance calculations.

2.3 Previous Investigations

As part of the Nassau-Suffolk Regional Planning Board's 208 Study, a test well was drilled on the landfill's southern border, northwest of the Animal Shelter. The result of the field investigation and groundwater sampling are described in "Groundwater Studies for Section 208 Plan, Nassau and Suffolk Counties, Long Island, New York" (Woodward-Clyde Consultants, 1977).

To evaluate the vertical component of groundwater flow and groundwater contamination at the site, three temporary screen settings were pumped and sampled. Twenty-foot lengths of screen were set at 188 to 208 feet below grade, 358 to 378 feet and 528 to 548 feet. Water levels collected at the three screen settings showed a drop of 0.8 feet between the upper and middle settings. The water level measured in the lower setting was the same as that in the upper setting, indicating at least partial confinement of groundwater in the middle of the Magothy aquifer.

Groundwater samples did not detect significant leachate contamination at any of the horizons tested. The upper and middle settings had elevated specific conductance readings associated with higher than background levels of chloride calcium, sodium and magnesium. Heavy metals, halogenated hydrocarbons and organics were not detected.

SECTION 3.0

INSTALLATION OF MONITORING WELLS

3.1 Methodology

To collect the geologic and hydrogeologic data required for an accurate assessment of groundwater quality and flow conditions at the Syosset landfill, seven monitoring wells were installed between October 14 and October 21, 1982. The well locations are shown in Figure 3-2. The wells were located around the periphery of the landfill because of the proximity of the regional water table divide and the ambiguous groundwater head information available before the start of drilling. It was felt that encircling the site with monitoring wells would provide enough water level information to reliably determine the local groundwater gradient as well as characterize "worst case" downgradient water quality.

Drilling for well SY-6 began on October 14 using hollow stem augers. It was initially planned to collect a split spoon sample at 145 feet, in the middle of the proposed SY-6 screened interval (140 to 150 ft.), however, this plan was dropped because of technical considerations. The well was completed on October 19, 1982. Augers were successfully used to install the remaining six wells. To characterize the deposits encountered during drilling, well cuttings brought up by the auger flytes were monitored in conjunction with discussions with the driller who could distinguish changes in the texture of materials.

To monitor surficial groundwater quality, each screen was set 30 to 40 feet below the water table. Site specific conditions, including the presence of significant clay strata, were used to determine the actual setting in the field. Individual well construction details have been shown graphically in the logs presented in Appendix A.

Following installation, each well was developed by air lift pumping for a minimum of two hours. The specific conductance of the discharge was measured at 15-minute intervals and development was considered to be complete when conductivity remained stable for several successive readings.

3.2 Geologic Setting

To characterize the subsurface deposits in the vicinity of the Syosset landfill, a geologic cross section was prepared using driller's logs from wells drilled in the area with supplemental information collected during the current drilling program. The cross section is shown in Figure 3-1.

Pleistocene glacial deposits consisting of medium to coarse sand and gravel are found from the surface to about 75 feet below grade. The elevation of the Pleistocene-Cretaceous contact is relatively constant in the vicinity of the landfill. The question marks shown on the contact in Figure 3-1 reflect alternative interpretation of the N4133 log in U.S. Geological Survey reports.

Isbister (USGS Water Supply Paper 1825, Plate 2) has shown the surficial deposits around the landfill to be well-sorted and stratified glacial outwash. Less than a quarter mile north, however, are unsorted Ronkonkoma terminal moraine deposits. The proximity of the moraine and the limited distance available for sorting by fluvioglacial meltwaters may account for the coarse gravel and cobbles encountered during drilling.

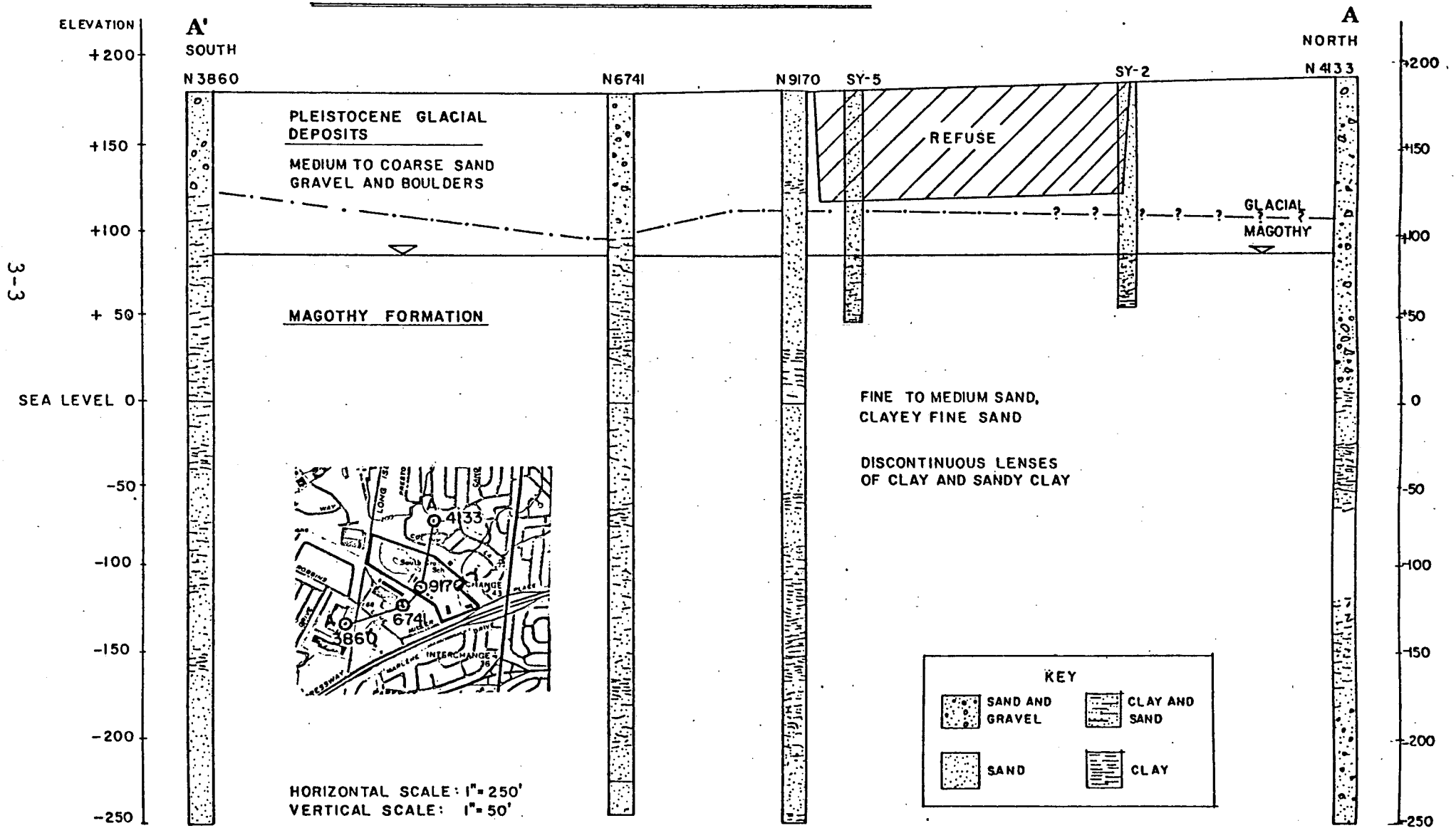
The Late Cretaceous Magothy Formation is found beneath the site from about 120 feet above sea level to 450 feet below sea level. Figure 3-1 shows the contact is a relatively abrupt shift from coarse sand to silty fine sand and clay. The Magothy is variable both horizontally and vertically and is characterized by discontinuous lenses of clay and sandy clay particularly in the upper section.

All seven wells installed at the Syosset landfill penetrated the Magothy and considerable variation was evident even over short distances. The uppermost Magothy deposits ranged from well-sorted tan medium fine sand with mica and interstitial silt and clay to dark gray micaceous clayey fine sand. Thick sections of dense plastic clay or interbedded clay strata were encountered in every hole (except SY-5) between 115 and 145 feet. The clay lenses also varied with respect to color, thickness, texture, depositional character and elevation.

3.3 Hydrogeology

To determine the local and regional groundwater gradient, two sets of synoptic water level measurements were collected from the seven landfill wells and from six surrounding Nassau

FIGURE 3-1 GEOLOGIC SECTION, SYOSSET LANDFILL



County and U.S. Geological Survey observation wells (well locations are shown on Figure 3-3). Table 3-1 summarizes the water level measurements.

The configuration of the water table beneath the Syosset landfill is shown in Figure 3-2. The contours are based on water levels collected on December 1, 1982. Figure 3-2 clearly indicates that groundwater flow is to the north and northeast. The groundwater gradient is relatively uniform with a decrease in head of 1.5 to 2.0 feet between the south and north boundaries. Water level measurements in the seven wells were all consistent with respect to each other. Repeated measurements were also consistent over time.

A comparison of water table elevations beneath the landfill and glacial - Magothy contact shown in Figure 3-1 shows that the water table in the area is in the Magothy and the unsaturated zone includes all of the glacial deposits.

A regional water table map, presented in Figure 3-3, shows that the landfill site is marginally north of the main groundwater divide and is located on the north edge of an enclosed groundwater high. The area adjacent to the groundwater divide is the site of recharge to middle and lower portions of the Magothy aquifer and vertical groundwater flow can be expected to be important. The wells installed during this project were not designed to evaluate vertical head distrubtion, however, as previously described the 208 Study wells did show a drop in head of 0.8 feet between 200 feet and 370 feet. Because heads decrease horizontally and vertically at the site, groundwater (and leachate) will tend to migrate both laterally and downward away from the landfill. The rate of horizontal flow will be significantly greater than the vertical velocity because of the anisotropic nature of the Magothy aquifer.

To estimate the rates of vertical and horizontal flow, the following equation based on Darcy's Law can be used:

$$V = \frac{PI}{7.48\ p}$$

where,

V = Velocity in feet per day

P = Permeability in the direction of flow in gallons per day per square foot

I = hydraulic gradient in ft./ft.

p = porosity (dimensionless).

FIGURE 3-2 LOCAL WATER TABLE CONTOURS - SYOSSET LANDFILL

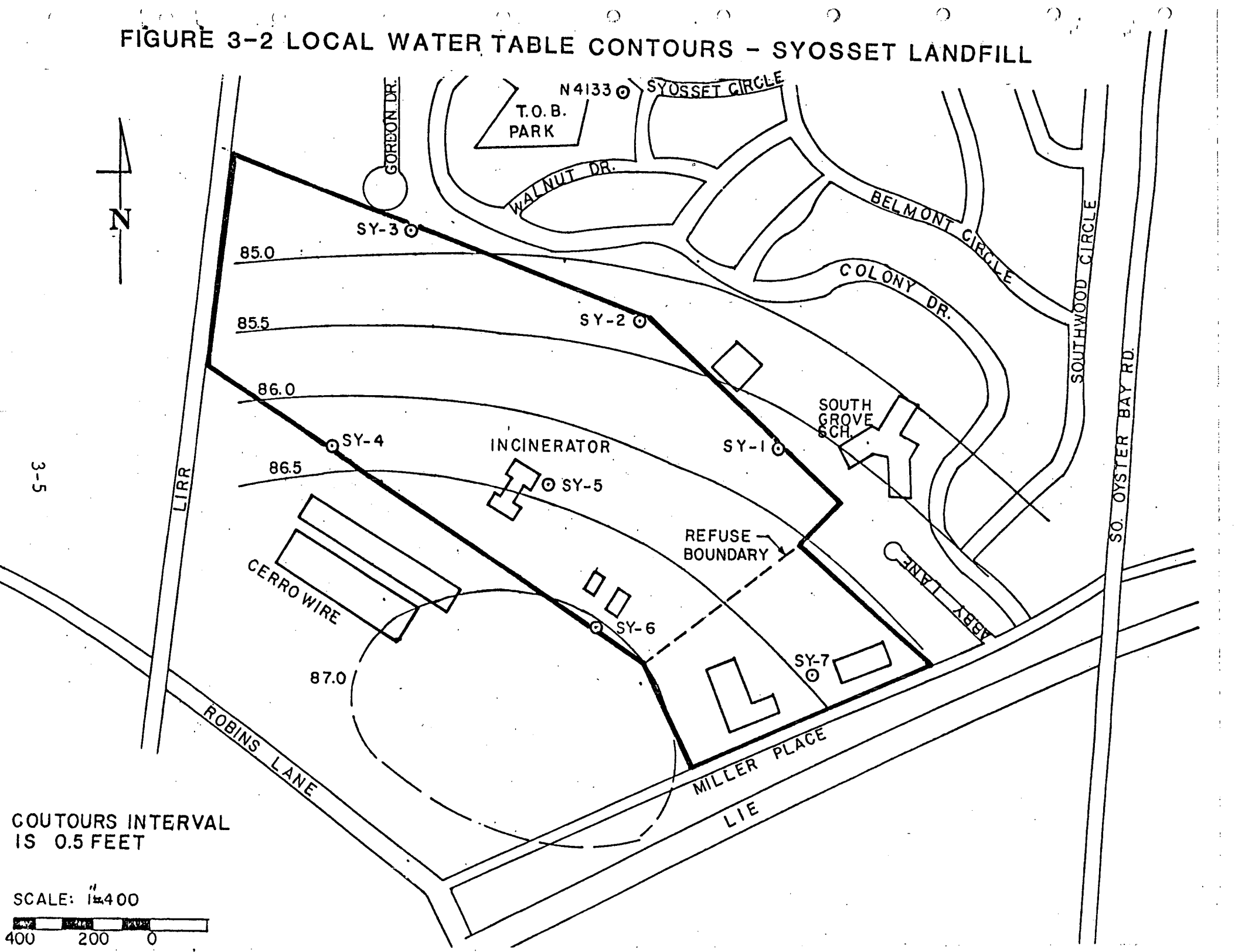


Table 3-1

WATER LEVEL MEASUREMENTS

SYOSSET LANDFILL

WELL NUMBER	CASING ELEVATION	November 4, 1982		December 1, 1982	
		DEPTH TO WATER	WATER TABLE ELEVATION	DEPTH TO WATER	WATER TABLE ELEVATION
SY-1	194.52	108.41	86.11	108.84	85.68
SY-2	182.40	96.96	85.44	97.12	85.28
SY-3	191.00	106.05	84.95	106.22	84.78
SY-4	193.17	106.24	86.93	106.74	86.43
SY-5	178.01	91.00	87.01	91.58	86.43
SY-6	185.84	98.04	87.80	98.74	87.10
SY-7	199.43	112.63	86.80	112.97	86.46
N1229	250.35	--	--	174.58	75.77
N7478	217.22	--	--	134.46	82.76
N8888	174.49	--	--	89.82	84.87
N9089	172.49	--	--	90.60	82.38
N9317	217.45	--	--	146.32	71.13
N9920	145.95	--	--	66.21	79.74

FIGURE 3-3 REGIONAL WATER TABLE MAP—SYOSSET LANDFILL

For horizontal flow, site specific permeability can be determined from pump tests conducted during the development of the 208 Study wells. The specific capacity measured for the uppermost screen setting was 5.2 gpm per foot of drawdown. Using equations described by McClymonds and Franke (USGS Professional Paper 627-E, p. E11, 1972) a permeability value of 520 gpd/sq. ft. was calculated. The hydraulic gradient measured from Figure 3-2 is .002 ft./ft. (about 10 feet per mile.) A porosity of 30 percent was assumed. Using these values, an average horizontal velocity of 0.46 feet/day was calculated.

The ratio of horizontal to vertical permeability in the Magothy is generally estimated to be 10:1. A vertical permeability of 5.2 gpd/sq. ft. will, therefore, be used. The vertical gradient, based on head measurements in the 208 wells is .0047 ft./ft. A porosity value of .3 will again be used. The vertical velocity is found to be 0.11 ft./day. This value, however, reflects vertical flow in the sandier beds of the Magothy where the 208 wells were screened. Groundwater flowing vertically from the site would pass through significant bodies of clay that further impede movement. Isbister (1966) discusses the rate of groundwater movement through clay in northeast Nassau County and he estimates velocities would range between .0001 and 0.0000001 ft./day. These flow rates show that the horizontal transport of leachate from the Syosset landfill is of greater importance than corresponding vertical migration.

SECTION 4.0

SAMPLING PROCEDURES AND ANALYTICAL RESULTS

4.1 Groundwater Sampling

The initial set of groundwater samples were collected from the seven landfill monitoring wells by NCDH personnel between November 4 and November 9, 1982. A second round of samples were collected on December 3-6, 1982.

Prior to the collection of samples, each well was sounded and the volume of standing water in the well casing was determined. Individual stainless steel bailers (1.5 inch diameter, 3 feet long) were used to thoroughly evacuate each well, removing at least one casing volume. To prevent cross contamination, the bailers were labeled and only used to collect samples from a single well. The same procedure was used to collect the second set of samples.

The samples, which were analyzed for the EPA priority pollutants, an expanded list of heavy metals and general water quality parameters, were taken directly from the landfill to the Nassau County Department of Health Laboratories where preservation and processing took place.

4.1 Analytical Results

The analytical results from both sampling runs are shown in Tables 4-1, 4-2, and 4-3. Due to the extended period required for priority pollutnat extraction and analysis and project completion requirements, several groups (i.e. acid extractables, base neutrals, vinyl chloride, pesticides, PCB's) of priority pollutant parameters could not be included in this report.

Table 4-1

ANALYTICAL RESULTS - INORGANIC CONSTITUENTS

SYOSSET LANDFILL

PARAMETER	WELL NUMBER													
	#1		#2		#3		#4		#5		#6		#7	
	11/82	12/82	11/82	12/82	11/82	12/82	11/82	12/82	11/82	12/82	11/82	12/82	11/82	12/82
Spec. Cond. (umhos)	2780	2840	1620	1590	2620	2620	1150	1120	1120	1150	590	470	1140	1060
pH	7.8	6.7	6.6	6.5	7.3	7.3	8.7	8.9	7.7	8.4	7.0	8.2	6.1	6.2
Total Solids	1770	*	962	*	968	*	798	*	728	*	376	*	1015	*
Total Hardness (mg/l) ($CaCO_3$)	301	*	274	*	449	*	200	*	237	*	96	*	246	*
Calcium Hardness (mg/l) ($CaCO_3$)	180	*	156	*	177	*	166	*	207	*	67	*	144	*
Total Akalinity (mg/l) ($CaCO_3$)	455	440	270	260	204	1220	31	37	34	43	62	69	73	110
COD	*	278.0	*	105.0	*	210	*	61.0	*	32.2	*	56.4	*	56.4
Free CO_2	14	*	131	*	20	*	<1	*	1	*	12	*	112	*
MBAS	.24	.24	.15	.11	.44	.30	.32	.21	.34	.18	.14	<.2	.33	.22
Ammonia (mg/l) N	54.0	6.34	6.8	*	140.0	4.48	4.5	5.51	6.5	4.08	3.7	3.34	.96	2.14
Nitrite (mg/l) N	.019	.009	.095	.029	.06	.013	1.64	*	3.01	9.82	.206	.17	2.12	*
Nitrate (mg/l) N	.37	.14	.56	.29	.63	.16	23.0	*	*	27.90	6.64	5.50	17.00	3.70
SiO_2	8.5	7.8	4.4	4.2	119	11.7	6.4	3.0	1.8	2.5	3.1	2.2	7.6	7.7
Fluoride	<2	<2	<2	<.2	.45	<.2	.3	.35	<.2	3.5	2.05	<2	<.2	<2
Chloride	602	540	316	314	156	182.5	164	171	200	176	68.8	57.2	569	235
SO_4	275	138	155	108	33	2	255	198	210	175	125	*	105	*
Na	370	410	210	210	185	190	165	170	150	160	69.0	66.0	120	120
K	70.0	72	10.5	136	145	136.0	5.0	6.1	3.4	2.4	5.0	*	3.9	*
CA	79.0	72	77.5	76.0	78.0	62.0	93.5	69.0	83.0	80.0	30.0	22.2	67.0	56.0
Mg	29.5	44.0	37.0	34.0	58.0	58.0	8.7	6.8	72.25	61	100.0	5.0	135.0	19.1
Mn	1.23	1.08	2.80	1.45	0.32	0.26	0.57	.50	.30	.20	.47	.34	1.22	.46
Fe	120.0	103.0	195.0	84.0	50	27.5	87	76	72.25	28.8	100.0	53.50	135	0

Note: All values in mg/l unless otherwise noted.

* - Not reported.

Table 4-2

ANALYTICAL RESULTS - HEAVY METALS

SYOSSET LANDFILL

(All results in mg/l)

PARAMETER	WELL NUMBER #1 11/82	#1 12/82	#2 11/82	#2 12/82	#3 11/82	#3 12/82	#4 11/82	#4 12/82	#5 11/82	#5 12/82	#6 11/82	#6 12/82	#7 11/82	#7 12/82
Silver (Ag)	<.05	<.05	<.05	<.05	<.05	<.05	<.05	<.05	<.05	<.05	<.05	<.05	<.05	<.05
Arsenic (As) .01	.18	.045	.09	<.005	.081	.046	.038	<.005	.125	<.005	0.15	<.005	.055	<.005
Barium (Ba)	<.5	<.5	<.5	<.5	<.5	<.5	<.5	<.5	<.5	<.5	<.5	<.5	<.5	<.5
Beryllium (Be)	<.005	*	<.005	*	<.005	*	<.005	*	<.005	*	<.005	*	<.005	*
Cadmium (Cd) .01	.023	.003	.085	.002	.004	<.001	.014	.004	.028	.002	.C5	.006	.055	<.001
Total Chromium (Cr) .05	.19	.17	.42	.10	.25	.03	.40	.08	.11	.04	.38	.07	.20	<.01
Copper (Cu)	.18	.15	.43	.08	.15	<.05	.17	.12	<.05	<.05	.34	.10	.17	<.05
Mercury (Hg)	<.0005	*	<.0005	*	<.0005	*	<.0005	*	<.0005	*	<.0005	*	<.0005	*
Nickel (Ni)	.10	*	.19	*	.16	*	.15	*	<.05	*	.19	*	.09	*
Lead (Pb) .05	.09	.55	1.10	.32	1.10	.19	.49	.58	1.90	.10	.12	.30	.09	.06
Selenium (Se)	<.005	<.005	<.005	<.005	<.005	<.005	<.005	<.005	<.005	<.005	<.005	<.005	<.005	<.005
Antimony (Sb)	<.01	*	<.01	*	<.01	*	<.01	*	<.01	*	<.01	<.01	<.01	*
Thallium (Tl)	<.01	*	<.01	*	<.01	*	<.01	*	<.01	*	<.01	<.01	<.01	*
Zinc (Zn)	.17	*	1.05	*	.31	*	.32	*	<.05	*	.50	*	.17	*

*-Not Reported

Table 4-3

ANALYTICAL RESULTS - HALOGENATED AND NON-HALOGENATED ORGANICS

SYOSSET LANDFILL

(All results in ug/l)

PARAMETER	DETECTION LIMIT	WELL NUMBER													
		#1		#2		#3		#4		#5		#6		#7	
		11/82	12/82	11/82	12/82	11/82	12/82	11/82	12/82	11/82	12/82	11/82	12/82	11/82	12/82
Volatile Halogenated															
Methylene Chloride	5	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Trichlorofluoromethane	1	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
1,1 Dichloroethylene	1	BDL	4	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
1,1 Dichloroethane	4	5	4	BDL	5	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
1,2 Dichloroethylene	1	BDL	BDL	5	4	BDL	BDL	BDL	1	BDL	BDL	BDL	BDL	5	4
Chloroform	1	BDL	BDL	BDL	BDL	BDL	BDL	19	13	14	10	4	3	11	15
1,1,2 Trichlorotrifluoroethane	1	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
1,2 Dichloroethane	4	BDL	BDL	BDL	5	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Carbon Tetrachloride	1	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
1,2 Dichloropropane	2	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Bromodichloromethane	1	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Trichloroethylene	1	BDL	BDL	1	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	1	1
1,1,1 Trichloromethane	1	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Bromoform	1	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	2	1
Tetrachloroethylene	1	BDL	BDL	1	2	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Volatile Non-Halogenated															
Benzene	4	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Toluene	4	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Chlorobenzene	5	18	21	5	12	20	19	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Ethylbenzene	3	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Xylene	4	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Dichlorobenzene	10	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL

BDL - Below Detectable Limits

SECTION 5.0

DISCUSSION OF RESULTS

A review of the analytical results from the seven landfill monitoring wells shows elevated concentrations for a broad group of inorganic constituents. High concentrations of ammonia, chloride, sodium sulfate, calcium, iron, alkalinity, hardness, and specific conductance are of particular interest. These constituents have been cited by numerous landfill studies (Kimmel and Braids, 1977; EPA Manual SW-611, 1977; Hughes, Landon and Farvolden, 1971) as important indicators of leachate generated by municipal landfills. Heavy metals and volatile organics were also found at low to moderate concentrations. The analytical results generally indicate that leachate characteristic of municipal landfills is being generated at the Syosset landfill.

To evaluate the strength of the leachate, the monitoring well results can be compared to water quality data from monitoring wells in the vicinity of the landfill. Table 5-1 presents water quality results from two wells located immediately upgradient at Cerro Wire (N3569 and N6741), a well about one mile south of the landfill (N6531) and a well on the Syosset Hospital property (N7052) about 4,000 feet north of the landfill (well locations are shown on Figure 3-3).

The background concentrations for all the parameters are uniformly lower than those found in the landfill wells. Ammonia levels, a good leachate indicator, are below 1.0 mg/l for the background wells while at the landfill ammonia is found at concentrations up to 140 mg/l. The difference in iron concentrations is also large; an average of 100 mg/l in the plume and a maximum of 2.45 outside the plume. The shallower Cerro Wire well, N3569, which is only 200 feet south of the landfill, has elevated chloride, sodium, sulphate and hardness concentrations that are almost identical to those found in SY-6. This indicates either low level leachate impact due to local gradient reversal from pumpage (the well is rated at 1000 gpm) or the effect of waste disposal on the Cerro property. In general, the difference in water quality beneath the landfill and surrounding the site is clear and the degree of degradation is shown to be significant.

Heavy metal and volatile organic concentrations are lower than anticipated considering the history of industrial waste disposal at the site. Arsenic, cadmium, chromium and lead

Table 5-1

BACKGROUND WATER QUALITY

NEAR THE SYOSSET LANDFILL

	WELL NUMBER			
	N7052	N6741	N3569	N6531
Screen Elevation	-14	-183	-154	+61
Total Alkalinity	28	6	9	12
Hardness	118	24	154	53
pH	6.7	6.0	5.8	6.2
Ammonia	ND	.01	.27	.05
Nitrate	9.42	2.16	6.81	4.6
Chlorides	30	11.5	87.0	23
Sulphate	38	13	150	34
Sodium	21.0	8.0	65	20
Iron	1.44	.38	.32	2.45
Date of Analysis	9/79	2/80	2/80	4/79

All values in mg/l.

concentrations exceed the levels set by the primary drinking water standards. The concentration of these constituents is significantly higher than the concentrations reported by Kimmel and Braids (1977) for the Babylon and Islip landfills and this may relfect the disposal of industrial wastes at Syosset. Heavy metal ions are generally not highly mobile because of adsorption from solution by clay particles and this may account for the low to moderate concentrations.

Volatile halogenated and non-halogenated organics on the other hand are more mobile constituents and should be detected if present. The low concentrations found are not significantly different from background levels in many parts of Nassau County. The low volatile organic concentrations may be due to mass burning that took place at the site or leaching of the organics may have occurred in the past and they have already migrated off-site.

An evaluation of the water quality results in conjunction with the hydrogeologic data shows a consistent pattern of leachate transport that confirms the groundwater gradient presented in Figures 3-2 and 3-3. Parameter concentrations are generally higher in the wells on the downgradient side of the landfill (SY-1, SY-2, and SY-3) than in the wells on the upgradient side of the site. Well SY-6 which has the highest water table elevation also has the lowest conductivity, total solids, chloride, sodium, calcium and hardness concentrations.

The nitrogen series (ammonia, nitrite, nitrate) results are also consistent with respect to groundwater flow patterns at the site. Nitrogen is a major component of municipal refuse and scavenger waste and in the anerobic environment that is generally found in landfills, ammonia is the dominant nitrogen species. Under aerobic conditions, ammonia will be oxidized and converted to nitrate. On the upgradient side of the landfill, wells SY-4 through SY-7 have moderate ammonia levels and very high nitrate concentrations. This indicates the unsaturated zone is aerobic and groundwater moving on to the site from upgradient contains sufficient oxygen to convert the ammonia to nitrate. The downgradient wells have high ammonia and low nitrate concentrations indicating that anaerobic conditions prevail in the thick unsaturated zone and below the water table. As the plume migrates downgradient, the oxidation of the ammonia to nitrate can be expected.

The quality of groundwater flowing vertically beneath the site can be evaluated by comparing the analytical results from well SY-6 to results from the 208 Study wells. These wells are

both located near the animal shelter on the site's south boundary, however, the 208 wells were screened much deeper. The concentration of constituents that tend to be conservative, not subject to attenuation, are very similar in SY-6 and the 208 wells screened at 200 and 375 feet. Chloride, sodium, calcium, sulfate and conductivity levels are approximately equal. The concentration of metals, which are rapidly adsorbed onto clay particles are sharply different between SY-6 and the upper two 208 wells. Iron was found to be 100.0 mg/l in SY-6 but less than 1.0 mg/l in the 208 wells. Lead, chromium, nickel, copper and arsenic which were all found in SY-6 were not detected in the 208 wells. This seems to indicate that the plume is migrating vertically in response to a decrease in head, the hazardous heavy metals are being effectively attenuated by the clayey deposits that are found in the upper part of the Magothy. Additional monitoring at lower depths on the downgradient side of the landfill is required to conclusively demonstrate that this occurs beneath the entire site.

SECTION 6.0

CONCLUSIONS AND RECOMMENDATIONS

6.1 Conclusions

Based on the information collected during this project, the following conclusions regarding the Syosset landfill can be made:

1. Lateral groundwater flow beneath the site is to the north and northeast. The rate of lateral flow is approximately 0.46 ft./day.

2. The site is located less than 1,000 feet north of the regional water table divide. Head decreases with depth and vertical flow is occurring; however, its rate is much slower than lateral flow. The calculated vertical flow is approximately 0.11 ft./day.

3. Based on information collected from the monitoring wells, leachate is being generated at the Syosset landfill. The leachate-impacted groundwater is characteristic of that found beneath municipal landfills except for lead, arsenic, chromium and cadmium concentrations that may reflect industrial waste disposal at the site.

4. Analytical results indicate groundwater quality within the plume is highly variable. This variability is consistent with leachate production and transport phenomena observed at other Long Island landfills.

5. Lead, for which the drinking water standard is 0.05 mg/l was found in concentrations that ranged from 0.06 mg/l to 1.90 mg/l. Cadmium concentrations ranged from less than 0.001 mg/l to .085 mg/l; the drinking water standard is 0.01 mg/l. Chromium concentrations ranged from less than 0.01 mg/l to 0.42 mg/l and arsenic ranged from less than 0.005 mg/l to 0.18 mg/l The drinking water standard for chromium and arsenic is 0.05 mg/l.

6. Metals in the leachate are apparently being effectively attenuated by extensive clay deposits found beneath the site. Analytical results from the 208 Study wells and water supply well N4133 show metal concentrations are uniformly below detectable limits although conservative ions such as chloride and sodium are present near original levels.

7. Ammonia and nitrate seem to constitute the greatest groundwater impact. Nitrate concentrations above the drinking water standard of 10 mg/l NO_3-N can be expected downgradient.

8. Volatile halogenated and non-halogenated organic compounds were found at concentrations below the recommended New York State guidelines for drinking water. Volatile organic compounds are a minor component of the plume.

9. The areal extent of the plume could not be determined because of the limited monitoring network installed.

10. The two former public supply wells closest to the landfill, N4133 and N4246 were closed in the past due to water quality problems. The taste and odor problems that led to the closing of N4133 in 1973 were probably caused by leachate since this well is directly downgradient of the landfill. High 1,1,1 trichloroethane concentrations responsible for closing N4246 were not associated with the landfill.

11. Three operating public water supply wells are in the vicinity of the landfill. Well N6190 and N6191, owned by the Hicksville Water District, are about a mile south of the landfill and N6651, owned by the Jericho Water District, is 6,000 feet west of the site. These wells are not downgradient from the landfill and should not be impacted in the future by leachate constituents.

6.2 Recommendations

The following recommendations are based on the findings of ERM-Northeast's field investigation:

1. To prevent the generation of additional leachate, the site should be capped with impermeable material to prevent the continued infiltration of rain water. Provisions for venting methane should be incorporated into

the design of the cap. The installation of an impermeable cap will hydraulically isolate the refuse from the Magothy aquifer by preventing recharge from reaching the water table.

2. The seven monitoring wells installed at the landfill during this study should be sampled regularly for at least one year. This is necessary to thoroughly evaluate parameter concentrations in the plume and determine annual average and maximum leachate concentrations.

3. Because the landfill is located very close to the regional groundwater divide where vertical flow is an important consideration, additional deep monitoring wells should be installed on the downgradient (north side) of the landfill. These wells would permit a determination of plume thickness, vertical concentration gradients and vertical head distribution beneath the site. The wells should be installed close to wells SY-1, SY-2, and SY-3 so that the collected data can be effectively compared to existing information. Ideally, the new wells would be screened approximately 200, 300, and 400 feet below grade.

4. Groundwater quality downgradient of the landfill should be determined. The first step in this process could be the installation of shallow and medium depth wells at the Jericho Water District N4133 site on Syosset Circle or in the small Town park next to it. Wells in this location will give a preliminary indication of the affect of dilution and attenuation on the plume's concentration as it migrates downgradient. Information collected at this site can be used to guide further work. This may include the complete lateral delineation of the plume if required for comprehensive groundwater management planning.

5. Because of the dense residential development around the landfill and the proximity of public water supply wells, outpost monitoring wells should be installed upgradient to the south and the west. Annual monitoring of these wells would permit an evaluation of water table changes and potential plume movement in the future.

SECTION 7.0

BACKGROUND

7.1 Site Description

The Denton Avenue landfill consists of two separate 27 acre rectangular plots on the west side of Denton Avenue in New Hyde Park. The landfill plots are bounded on the north by Hillside Avenue, Evergreen Avenue on the south and Leonard Avenue on the west. The two landfill plots are separated by a large recharge basin. The southern section is now the site of a North Hempstead recreational facility. The northern plot is an undeveloped field.

7.2 History of Site

The southern landfill parcel was originally a sandpit owned by the Flatlands Sand and Gravel Company. In 1953, landfill operations were initiated at the site, which was completely excavated at least 45 feet below grade (personal communication, William Cook, 1982). The excavation apparently extended below the water table in some areas because eyewitness reports describe ponded water at the bottom of the sand pit. The entire floor of the site was reportedly covered with refuse before intermediate cover was added and a new lift started. A total of five lifts were required to bring the excavated site to grade. The southern parcel was completed in 1963.

The northern plot is approximately the same size, 27 acres, and was also used for sand and gravel mining. Ponded water on the floor of the pit has been reported indicating that the excavation at least reached the water table. Apparently, some sections of the landfill were started below the water table. This site became operational in 1963. By 1966, it had been filled to capacity and was closed. Following closure, Town personnel report clayey fill material was used to cover approximately 90% of the site. In some areas, the fill was reported to be four feet thick.

Historical information describing the type and quanity of refuse accepted at Denton Avenue is not available. Nassau County Department of Health and Town of North Hempstead officials were unable to identify any reports that quantify waste disposal at the landfill. William Cook, Superintendent of the Town's Sanitation Department, qualitatively described the

material accepted at both sites as municipal refuse. The only industrial waste accepted by the Town consisted of wood and cardboard. No drums or bulk waste was reported at either site.

To estimate the quantity of leachate generated during the active life of the Denton Avenue landfill sites and following site closure, the same methodology as previously described for the Syosset landfill was used. The assumptions for each site are listed below:

South Site

- Average annual precipitation equals 43.7 inches
- Runoff during operation was assumed to be zero. After closure, annual runoff was calculated to be about 11 inches. This assumes surficial material at the site is Soil Conservation Service hydrologic soil group A (high infiltration capacity). For three winter months the soil is assumed to be group D (low infiltration capacity) because of frozen conditions. Also, 77% of the site was classified as lawn and 23% as impervious surface.
- Irrigation of grass was added to monthly summer rainfall totals (June and September, 1.49 inches; July and August, 1.53 inches)
- Evapotranspiration was calculated to be 27 inches per year after closure and 3 inches per year during site operations.
- Soil moisture retention depth was estimated to be 2 inches.

North Site

- Runoff during operations was assumed to be zero. After closure runoff was estimated to be about 15.5 inches. This was based on soils at the site classed as hydrologic soil group C (shallow and clayey soils) reflecting the partial capping that has taken place. During three winter months, the soils are assigned to group D.
- Evapotranspiration was calculated to be about 24.5 inches after closure and 7 to 8 inches during operation.
- Soil moisture retention depth is 10.0 inches because of higher clay content.

Using these values, a recharge rate of 41 inches per year was calculated for both sites during operation. Assuming both sites are about 27 acres, the annual volume of leachate generated at each is approximately 30,087,000 gallons (82,400 gpd).

Monthly recharge calculations for the post-closure period (detailed in Appendix C) show annual recharge rates of about 11 inches at the south site and 7 inches at the north site. The volume of leachate generated at the south site was calculated to be about 8,064,000 gallons per year (22,100 gpd) following site closure. At the north site, approximately 5,132,000 gallons of leachate are generated per year (14,060 gpd).

7.3 Previous Investigations

No studies have been conducted that assess groundwater quality in the vicinity of the Denton Avenue landfill. A line of steel methane vents have been installed along the western boundary of the northern parcel; however, these perforated pipes were placed in the refuse and do not extend to the water table.

SECTION 8.0

INSTALLATION OF MONITORING WELLS

8.1 Methodology

Five monitoring wells were installed at the Denton Avenue landfill on November 11 and 12, 1982. Both the north and south landfill sites had two wells installed on their western boundaries and one well DA-3, was located about 800 feet west of the north site, on the property of the William Bowie School. Groundwater flow in the vicinity of the Denton Avenue landfill is clearly from east to west, thus the wells could be concentrated on the downgradient side of each site.

The same procedure that was used to install wells at Syosset was employed at Denton Avenue. Hollow stem augers were used to drill the bore hole and deposits were characterized by well cuttings brought up by the auger flytes. A limited attempt was made to evaluate vertical water quality concentrations by screening one well at each site at 95 feet and the other screen somewhat deeper (125 feet at the north site; 115 feet at the south site). The off-site well was screened at 100 feet. Construction details for each well are presented in the well logs in Appendix A.

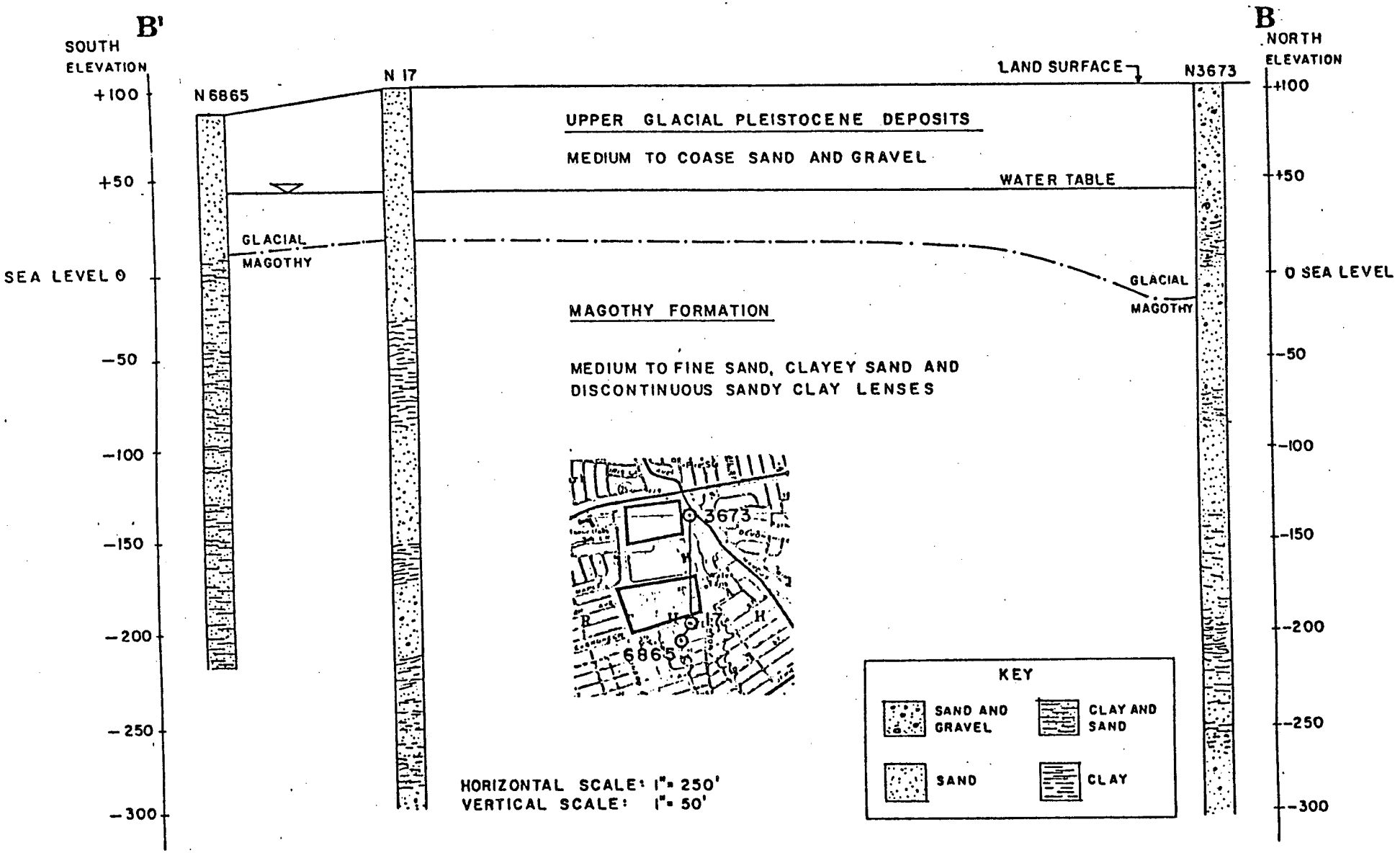
The wells were all developed by air lift pumping for two hours and the specific conductance monitored.

8.2 Geologic Setting

Subsurface deposits beneath the landfill sites are shown in Figure 8-1. The geologic cross-section was prepared using drillers logs from public supply wells located immediately west and south of the landfill. Additional stratigraphic information was also collected during the drilling program.

Glacial outwash deposits that consist of stratified medium to coarse sand and gravel are about 110 feet thick in the vicinity of the landfill. Wells DA-2, DA-3, and DA-4 are completely installed in coarse glacial material. Five to ten feet of fine to medium clayey micaceous sand, characteristic of the Magothy, were encountered in wells DA-1 and DA-5. Kilburn (Long Island Water Resources Bulletin 12, 1979) has shown the contact between the glacial outwash deposits and the glacial moraine to be about 1,500 feet north of the north landfill site.

FIGURE 8-1 GEOLOGIC SECTION DENTON AVENUE LANDFILL



The Magothy Formation is shown by Kilburn (1979) to be about 325 feet thick beneath the site extending from about -25 to -350 feet below sea level. Well logs show thick units of sandy clay near the top of the Magothy Formation. This was not confirmed during drilling because of limited penetration. Fine grained deposits at the top of the Magothy would tend to reduce hydraulic communication between the Magothy and upper glacial aquifers.

8.3 Hydrogeology

To prepare contour maps of the water table in the vicinity of the Denton Avenue landfill, a synoptic set of water levels were collected from the five landfill monitoring wells and from five nearby observation wells on December 7, 1982. The water level measurements are summarized in Table 8-1.

The configuration of the water table beneath the Denton Avenue landfill sites is shown in Figure 8-2, and the regional water table gradient is shown in Figure 8-3. Water levels collected from well DA-1 were not used to prepare these maps because of inconsistent erratic measurements. Repeated measurements at DA-1 showed the water level to be 1.0 to 1.5 feet too low when compared to DA-2 and DA-3, and the regional gradient established using all nine water levels. This may reflect surveyor error or problems associated with the packing of material around the screen.

Figure 8-2 and 8-3 show that groundwater flow is to the west and west-southwest. The gradient beneath the landfill is approximately 5.28 feet per mile (.001 ft./ft.). Using the McClymonds and Franke (USGS Professional Paper 627-E, 1972), regional estimates of hydraulic conductivity in the glacial aquifer of 2,000 gallons per day per square foot and an estimated porosity of 0.35, the average groundwater velocity in the upper glacial aquifer is calculated to be 0.76 ft./day.

The modification of the regional water table gradient by the large recharge basin that separates the two landfill sites is apparently minimal. Standing water was continually observed in the basin during the 18-month course of this project and the existence of a groundwater mound beneath the basin was anticipated. Water levels in wells DA-2 and DA-4 would have been preferentially higher if mounding occurred. Comparison of these water levels to regional water table trends show no artificial increase. This indicates that infiltration through the floor of the basin is low and that mounding is not currently occurring.

Table 8-1

WATER LEVEL MEASUREMENTS

DENTON AVENUE LANDFILL

WELL NUMBER	CASING ELEVATION	November 22, 1982		December 7, 1982	
		DEPTH TO WATER	WATER TABLE ELEVATION	DEPTH TO WATER	WATER TABLE ELEVATION
DA-1	108.62	68.25	40.37	69.43	39.19
DA-2	109.92	68.62	41.30	68.82	41.10
DA-3	121.50	81.10	40.40	81.04	40.46
DA-4	108-97	68.00	40.97	68.23	40.74
DA-5	109.67	69.03	40.64	69.23	40.44
1124	109.84			66.66	43.18
1683	82.77			50.69	32.08
8694	96.13			54.24	41.89
9982	120.07			86.32	33.75
9983	107.39			75.46	31.93

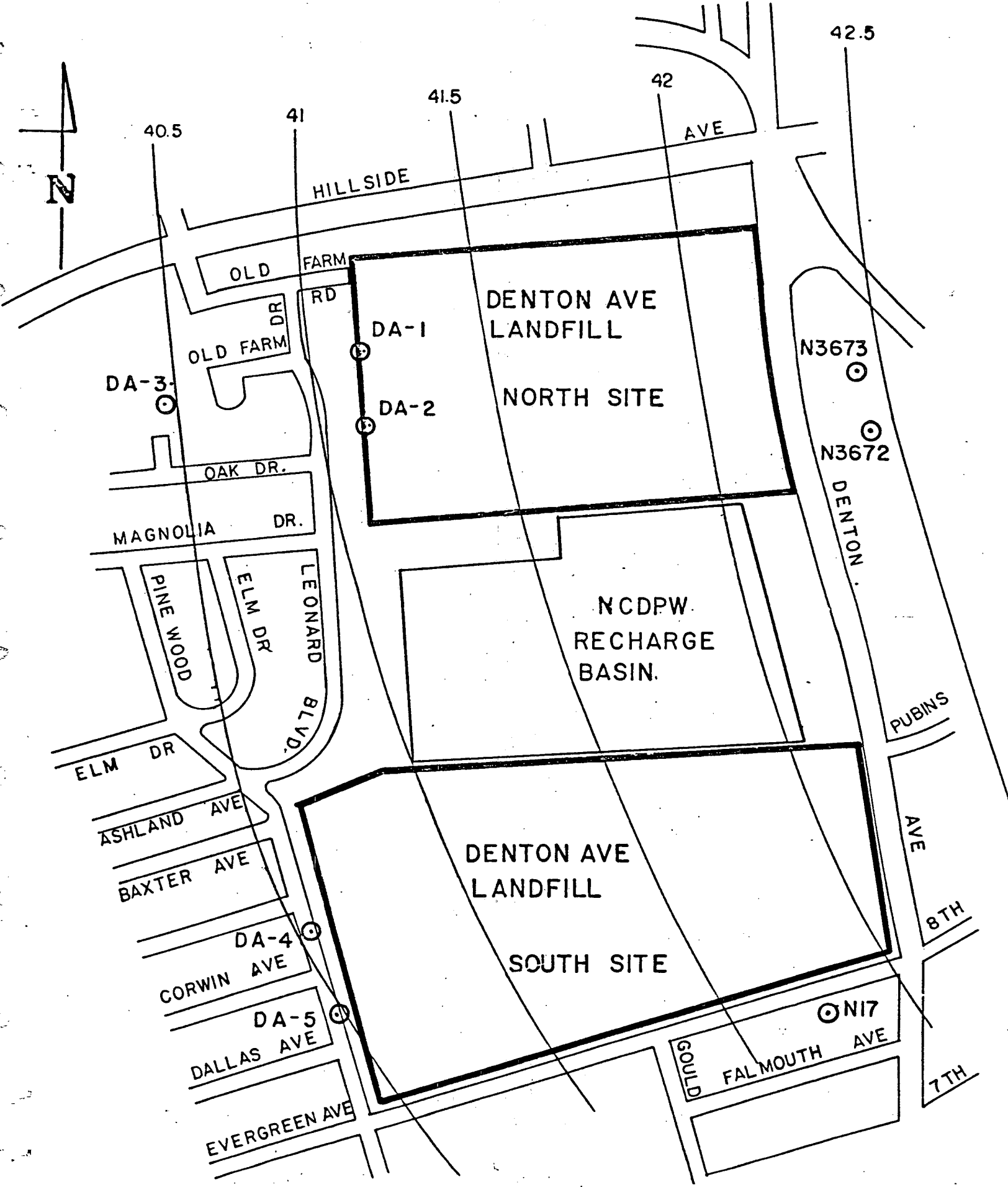


FIGURE 8-2 LOCAL WATER TABLE CONTOURS

DENTON AVE LANDFILL

IGURE 8-3 REGIONAL WATER TABLE MAP-DENTON AVE LANDFILL

Examination of Nassau County groundwater contour maps prepared by the U.S. Geological Survey (Swarzenski, 1963; Kimmel, 1970; Koszalka, 1974) shows the Denton Avenue landfill is located on or just north of the regional groundwater divide. The area adjacent to the divide is generally characterized by vertical flow and recharge to the Magothy aquifer. The wells installed at the Denton Avenue site were not designed to evaluate the Magothy flow system so published data must be relied upon. Maps prepared by Swarzenski (1963) showing the piezometric surface in the Magothy aquifer indicate that lateral flow is in the same direction as the upper glacial aquifer. Heads in the Magothy are several feet lower than in the upper glacial confirming the existence of vertical flow. As previously described at the Syosset landfill, the comparatively low hydraulic conductivity and anistropy of the Magothy aquifer will result in greatly reduced lateral and vertical groundwater flow rates. Based on Swarzenski's maps, the gradient in the Magothy can be assumed to be roughly equal to the upper glacial gradient - .001 ft./ft. Assuming hydraulic conductivity is 400 gpd/sq. ft. (McClymonds and Franke, 1972) and porosity is .30, the average rate of groundwater flow is .18 ft./day. The rate of average vertical flow is estimated to be at least one order of magnitude lower depending on the thickness of local clay units.

SECTION 9.0

SAMPLING PROCEDURES AND ANALYTICAL RESULTS

9.1 Sampling Program

The same procedure used to sample the Syosset wells was used to sample the Denton Avenue wells. Prior to sampling, each well was sounded and at least one casing volume was removed using a stainless steel bailer. Each well was again assigned a unique bailer to prevent cross-contamination of samples. Samples were collected by Nassau County Department of Health personnel on November 22, 1982, with a second set collected on December 3, 1982. They were analyzed for EPA priority pollutants, an expanded list of heavy metals and general water quality parameters by the NCDH laboratory.

9.2 Analytical Results

The analytical results from both sets of samples are presented in Tables 9-1, 9-2, and 9-3. Acid extractables, base neutrals, pesticides, vinyl chloride, and PCB's were not completed in time to be included in this report.

Table 9-1

ANALYTICAL RESULTS - INORGANIC CONSTITUENTS

DENTON AVENUE LANDFILL

PARAMETER	WELL NUMBER									
	#1		#2		#3		#4		#5	
	11/82	12/82	11/82	12/82	11/82	12/82	11/82	12/82	11/82	12/82
Spec. Cond. (umhos)	446	448	243	269	252	258	293	330	258	274
pH	7.2	7.1	6.6	6.9	6.5	6.8	6.4	6.9	6.6	6.8
Total Solids	309	*	152	*	154	*	196	*	184	*
Total Hardness(mg/l)($CaCO_3$)	206	*	104	*	87	*	129	*	119	*
Calcium Hardness(mg/l)($CaCO_3$)	62	*	40	*	36	*	38	*	48	*
Total Akalinity (mg/l)($CaCO_3$)	108	112	22	36	29	31	54	72	65	71
COD	*	*	*	*	*	*	*	*	*	*
Free CO_2	13	*	11	*	118	*	42	*	32	*
MBAS	<.02	<.02	<.02	<.02	.25	<.02	<.02	<.02	<.02	<.02
Ammonia(mg/l) N	11.00	1.00	.17	.33	.05	.08	.16	.2	1.3	.78
Nitrite (mg/l) N	.011	.007	.006	.004	.02	.01	.02	.01	.01	.011
Nitrate (mg/l) N	<.01	.35	<.01	.11	1.13	1.32	.11	.15	.06	.21
SiO_2	3.6	4.3	5.1	5.0	4.8	4.0	6.1	6.0	6.9	6.8
Fluoride	<.2	<.2	<.2	<.2	<.2	<.2	<.2	<.2	<.2	<.2
Chloride	55.0	57.1	43.6	44.8	43.4	44.9	47.0	45.8	29	27.4
SO_4	18	<2	18	20	13	12	6	6.0	28	12
Na	42	44	21	23	28	30	38	40	20	22
K	16	13	2.5	3.3	3.8	5.5	3.7	5.5	4.9	6.3
Ca	25	19.7	16.1	17.5	14.4	14.5	15.3	16.2	19.3	22.1
Mg	8.4	7.7	3.7	3.7	3.2	2.8	4.2	3.6	4.5	4.4
Mn	1.25	0.97	1.54	1.93	.21	.17	1.21	1.25	1.02	1.10
Fe	61.0	75.0	27.0	40.0	21.0	24.0	41.0	53.0	29.0	34.0

Note: All values in mg/l unless otherwise noted.

* - Not reported.

Table 9-2

ANALYTICAL RESULTS - HEAVY METALS

DENTON AVENUE LANDFILL

(All results in mg/l)

PARAMETER	WELL NUMBER #1		#2		#3		#4		#5	
	11/82	12/82	11/82	12/82	11/82	12/82	11/82	12/82	11/82	12/82
Silver (Ag)	<.05	<.05	<.05	<.05	<.05	<.05	<.05	<.05	<.05	<.05
Arsenic (As)	<.005	<.005	<.005	<.005	<.005	<.005	<.005	<.005	<.005	<.005
Barium (Ba)	<.5	<.5	<.5	<.5	<.5	<.5	<.5	<.5	<.5	<.5
Beryllium (Be)	<.005	*	<.005	*	<.005	*	<.005	*	<.005	*
Cadmium (Cd)	.002	.009	.003	.017	.006	.014	.003	.008	.002	<.001
Total Chromium (Cr)	.01	.05	.03	.05	.03	.02	.09	.03	.02	.05
Copper (Cu)	<.05	.09	.06	.10	.07	.07	.08	.10	.07	.07
Mercury (Hg)	<.0005	*	<.0005	*	<.0005	*	<.0005	*	<.0005	*
Nickel (Ni)	<.05	*	<.05	*	<.05	*	<.05	*	<.05	*
Lead (Pb)	.05	.27	.62	.30	.17	.01	.34	.13	.14	<.01
Selenium (Se)	<.005	<.005	<.005	<.005	<.005	<.005	<.005	<.005	<.005	<.005
Antimony (Sb)	<.01	*	<.01	*	<.01	*	<.01	*	<.01	*
Thallium (Tl)	<.01	*	<.01	*	<.01	*	<.01	*	<.01	*
Zinc (Zn)	.41	*	.53	*	.30	*	.15	*	.10	*

* - Not Reported.

Table 9-3

ANALYTICAL RESULTS - HALOGENATED AND NON-HALOGENATED ORGANICS

DENTON AVENUE LANDFILL

(All results in ug/l)

PARAMETER	DETECTION LIMIT	WELL NUMBER #1		#2		#3		#4		#5	
		11/82	12/82	11/82	12/82	11/82	12/82	11/82	12/82	11/82	12/82
Volatile Halogenated											
Methylene Chloride	5	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Trichlorofluoromethane	1	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
1,1 Dichloroethylene	1	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
1,1 Dichloroethane	4	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
1,2 Dichloroethylene	1	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Chloroform	1	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
1,1,2 Trichlorotrifluoroethane	1	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
1,2 Dichloroethane	4	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Carbon Tetrachloride	1	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
1,2 Dichloropropane	2	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Bromodichloromethane	1	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Trichloroethylene	1	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
1,1,1 Trichloromethane	1	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Bromoform	1	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Tetrachloroethylene	1	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Volatile Non-Halogenated											
Benzene	4	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Toluene	4	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Chlorobenzene	5	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Ethylbenzene	3	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Xylene	4	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Dichlorobenzene	10	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL

BDL - Below Detectable Limits.

SECTION 10.0

DISCUSSION OF RESULTS

The monitoring well results do not show the dramatic water quality impacts normally associated with a plume of landfill leachate. To assess the low to moderately elevated anion and cation concentrations, the landfill monitoring wells must be compared to background water quality in the vicinity of Denton Avenue. Table 10-1 presents analytical results from five wells outside the influence of the landfill (Well N8694 is 3,000 feet south of the landfill; N8623 is 3,000 feet southeast of the site; N8026 is south-southwest; N4390 is 3,500 feet northwest and N3673 is 300 feet east; well locations are shown in Figure 8-3). The parameter concentrations in the five background wells show relatively little variation and provide a consistent basis for evaluating the monitoring well results.

The results from DA-1 clearly show some leachate impacts. The concentrations of ammonia, 11.0 mg/l and iron, 61 mg/l are very high and these constituents are traditionally good leachate indicators. Other anion and cation concentrations, however, are only moderately elevated. The conductivity, 466 umhos, is higher than the average background level, about 300 umhos, but much lower than the 2000 umhos found in the downgradient wells at the Syosset landfill. Similarly, the total alkalinity, total hardness, chloride and sodium concentrations are higher than background levels but they are not sharply elevated as might have been expected.

Interpreting the results from the other four landfill wells is more difficult. The conductivity in the landfill wells is equal to or even lower than background. Total hardness and total alkalinity concentrations are marginally greater in the landfill wells than the background wells. There is no significant difference between the sodium and chloride concentrations and the background sulfate and nitrate levels are higher than in the landfill wells. The only parameters that differ markedly from background levels are iron and manganese. The iron concentrations, which range from 21 mg/l to 75 mg/l and the manganese concentrations of 0.17 mg/l to 1.93 mg/l are commensurate with highly concentrated landfill leachate. Background iron concentrations in the area range from less than 0.5 mg/l to 2.9 mg/l.

Table 10-1

BACKGROUND WATER QUALITY

DENTON AVENUE LANDFILL

PARAMETER	WELL NUMBER				
	8026	8694	8623	4390	3673
Well Depth	-6	+16	+14	-141	-288
Screened Aquifer	Glacial	Glacial	Glacial	Upp.Mag.	Upp. Mag
Total Alkalinity	26	7	11	35	16
Hardness	74	73	71	94	74
Spec. Conductance	317	338	248	250	290
pH	6.2	6.0	6.2	6.4	6.1
Ammonia	.45	.07	<.01	<.01	<.01
Nitrate	5.47	4.6	6.65	4.6	10.50
Chlorides	27.8	41.4	12	28	19.4
Sulphate	40	85	31	32	46
Sodium	17	31.0	<3	14.0	14
Iron	2.9	<.5	.19	<.5	.26
Date of Analysis	6/81	8/82	1/81	1/80	5/79

Based on the fact that leachate of low to moderate strength is being generated, at least at the north landfill site as shown by results from DA-1, it is tentatively concluded that the high iron concentrations in all the wells are attributable to leachate impacts. The low concentrations of other leachate indicators may indicate that the majority of the refuse decomposition and leaching occurred in the past and the contaminated groundwater has already migrated off-site. Partial capping of the north site with clayey material may also be reducing the quantity of leachate generated. Persistent high iron concentrations may reflect iron-rich refuse that was deposited at both sites.

Another indication that the five monitoring wells are screened in leachate enriched groundwater is the uniform presence of cadmium, chromium, lead and zinc in all samples. Although only lead was found in significant concentrations (equaling or exceeding the drinking water standards in all but two samples), even the low level identification of these metals is important. These parameters have not been detected in any of the observation wells in the vicinity of the landfill which indicates there are no other sources in the area that can account for the positive levels in the landfill wells.

None of the volatile organics tested for were identified in the landfill well samples. Halogenated organics are widely distributed in the upper glacial and Magothy aquifers in the New Hyde Park area and were responsible for the closing of supply wells N3672 and N3673 immediately upgradient from the north site. The absence of organics in the landfill samples and the low inorganic concentrations in the supply well analyses tend to show that the landfill was not responsible for the well closures. Jamaica Water Co. supply well N17, located immediately south of the south site, has also never been affected by leachate from the nearby south landfill site.

SECTION 11.0

CONCLUSIONS AND RECOMMENDATIONS

11.1 Conclusions

Based on information collected during the groundwater investigation at the Denton Avenue landfill, the following conclusions can be made:

1. Lateral groundwater flow in the upper glacial aquifer beneath the site is to the west and southwest. The average flow rate is 0.76 ft./day.

2. The landfill sites are located on or just north of the regional groundwater divide.

3. Leachate, characteristic of municipal refuse decomposition, is being generated at both landfill sites. The major components of the leachate-impacted groundwater are iron (concentration range - 21.0 mg/l to 75.0 mg/l), manganese (concentration range - 0.17 mg/l to 1.93 mg/l), and ammonia (concentration range - 0.05 mg/l to 11.0 mg/l. Lead, for which the drinking water standard is 0.05 mg/l, was found to range from less than 0.01 mg/l to 0.62 mg/l. Chromium, cadmium and zinc were detected below drinking water standards.

4. Volatile organic compounds were not detected in the monitoring well samples.

5. A plume of groundwater contaminated primarily by iron and lead has migrated at least 800 feet downgradient of the north landfill site based on water quality results in the off-site monitoring well.

6. Active and closed public water supply wells near the landfill have not been affected by leachate. Because both the landfill and the supply wells have been in existence for 15 or 20 years, new leachate impacts on public water supplies are not likely to develop in the future.

11.2 Recommendations

1. The wells installed during this study should be sampled regularly for at least a year to evaluate average annual and maximum plume concentrations. The review of data collected over the course of a year will permit a comprehensive assessment of leachate strength.

2. Because the landfill is located close to the groundwater divide where vertical components of flow are important, the head relationship between the upper glaical and Magothy aquifers should be quantified. This would require the installation of two or three additional wells at each landfill site. Water samples obtained from these wells would also establish vertical concentration gradients.

3. Major remedial measures do not seem to be warranted at either site because of the low strength of the leachate being produced, the absence of public water supply impacts and the partial capping that has already taken place. Minor remedial actions that would further reduce leachate generation are desirable.

   At the north site, the extent of the clayey fill should be determined by conducting a series of shallow soil borings. The permeability of this material should be measured. Fill with a low permeability should be added to those portions of the site not covered by the original clayey fill. Finally, the entire site should be regraded to facilitate positive drainage toward the periphery and eliminate the small depressions that currently collect and store runoff.

   At the south site, regrading or additional paving would decrease infiltration and leachate production, although modification to the ball fields and other outdoor recreation areas is not considered necessary.

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APPENDIX A

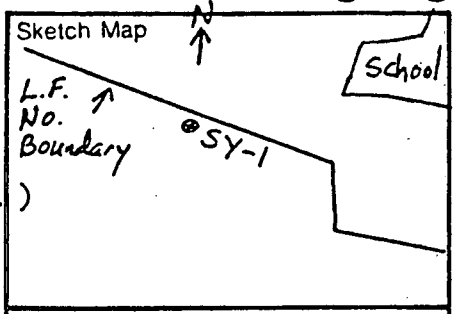
WELL LOGS

Environmental Resources Management

Drilling Log

Project NYSDOH Landfill Invest Owner
Location Syosset Landfill (N10045) W.O. Number
Well Number SY-1 Total Depth 135 ft. Diameter 8 in.
Surface Elevation 194.52 Water Level: DTW Initial 110' 24-hrs. 86.11 (elev.)
Screen: Dia. 2 in. Length 10 feet Slot Size .02 in.
Casing: Dia. 2 in. Length 125 feet Type steel
Drilling Company Layne-NY Drilling Method holl. stem auger
Driller Bill Sanford Log By C. Werle Date Drilled 10/19/82

Sketch Map



Notes
Bentonite seal (20lbs.) at 34'-35'

Depth (Feet)	Graphic Log	Well Construction	Sample Number	Description/Soil Classification (Color, Texture, Structures)
0			Meter Box	
10				Brownish-black medium to fine sand w/ gravel and cobbles - fill material to 8 feet.
20				Dark brownish tan medium to coarse quartzose sand and gravel, some fine sand, angular to subrounded.
30			Bentonite Seal	
40				Same as above.
50				
60				Materials change at 58' indicated by driller.
70				
80				Well sorted tan medium to fine sand with light tan interstitial clay.
90				
100				Grayish white clay stringer interbedded with well-sorted tan medium to fine sand.
110				
120				
130			Well Screen	Light gray plastic cohesive laminatec clay - clay parts along thin silty laminae, unit continuous from 135 to 145 ft.

Environmental Resources Management

Drilling Log

Project NYSDOH Landfill Invest Owner

Location Syosset Landfill (N10046) W.O. Number

Well Number SY-2 Total Depth 125 ft. Diameter 8 in.

Surface Elevation 182.40 Water Level: Initial DTW 97.0 24-hrs. 85.44(elev.)

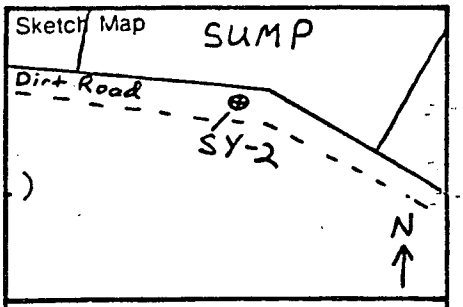
Screen: Dia. 2 in. Length 10 feet Slot Size .02

Casing: Dia. 2 in. Length 115 feet Type steel

Drilling Company Layne-NY Drilling Method holl.stem auger

Driller Bill Sanford Log By C. Werle Date Drilled 10/19/82

Sketch Map



Notes: Bentonite seal (20 lbs.) at about 40'

Depth (Feet)	Graphic Log	Well Construction	Sample Number	Description/Soil Classification (Color, Texture, Structures)
10				Dark brown organic rich top soil - medium to fine sand with cobbles.
20				Brown relatively well-graded medium quartz sand with 5% fine to medium gravel.
30				
40				Brownish tan medium to coarse sand with gravel and cobbles.
50				
60				
70				Dark brown medium to coarse sand with gravel and small cobbles.
80				
90				
100				
110				Dark gray medium to fine sand with interstitial clay.
120				
130				Gray cohesive laminated clay with thin interbedded orange and gray laminae and fine sandy micaceous seams from 125' to 130'.

Environmental Resources Management

Drilling Log

Project NYSDOH Landfill Invest Owner

Location Syosset Landfill W.O. Number

Well Number SY-3 (N10047) Total Depth 145 ft. Diameter 8 in.

Surface Elevation 191.00 Water Level: Initial DTW 106' 24-hrs. 84.95 (elev.)

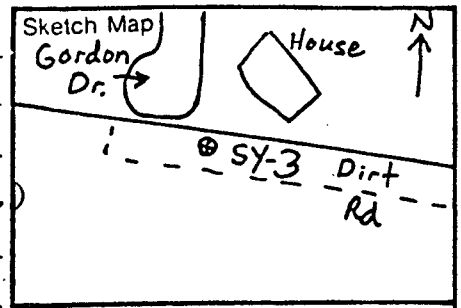
Screen: Dia. 2 in. Length 10 feet Slot Size .02

Casing: Dia. 2 in. Length 135 feet Type steel

Drilling Company Layne-NY Drilling Method holl. stem auger

Driller Bill Sanford Log By C. Werle Date Drilled 10/20/82

Sketch Map



Notes Bentonite seal (20 lbs.) at about 45'

Depth (Feet)	Graphic Log	Well Construction	Sample Number	Description/Soil Classification (Color, Texture, Structures)
10				Tan brown medium to coarse sand and gravel with cobbles and some fine sand.
20				
30				
40				Same as above
50				
60				
70				Same as above.
80				
90				
100				
110				Interbedded clay seams from 115' to 130', clay units of variable thickness from about 0.5 ft. to 2 feet.
120				
130				

Environmental Resources Management

Drilling Log

Project _____ Owner _____

Location _____ W.O. Number _____

Well Number SY-3 Total Depth _____ Diameter _____

Surface Elevation _____ Water Level: Initial _____ 24-hrs. _____

Screen: Dia. _____ Length _____ Slot Size _____

Casing: Dia. _____ Length _____ Type _____

Drilling Company _____ Drilling Method _____

Driller _____ Log By _____ Date Drilled _____

Sketch Map

Notes

Depth (Feet)	Graphic Log	Well Construction	Sample Number	Description/Soil Classification (Color, Texture, Structures)
140				(continued) Fine to medium sand with some interstitial clay.
150				

Environmental Resources Management

Drilling Log

Project NYSDOH Landfill Invest Owner

Location Syosset Landfill W.O. Number

Well Number SY-4 (N10048) Total Depth 153 ft. Diameter 8 in.

Surface Elevation 193.17 Water Level: Initial DTW 107.5 24-hrs 86.93 (elev.)

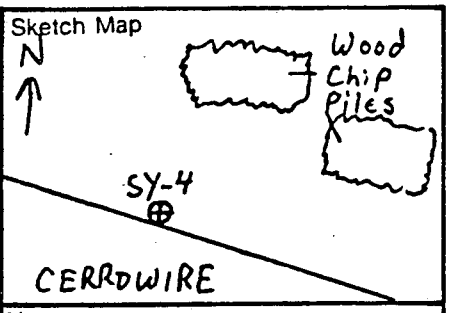
Screen: Dia. 2 in. Length 10 ft. Slot Size .02

Casing: Dia. 2 in. Length 143 ft. Type steel

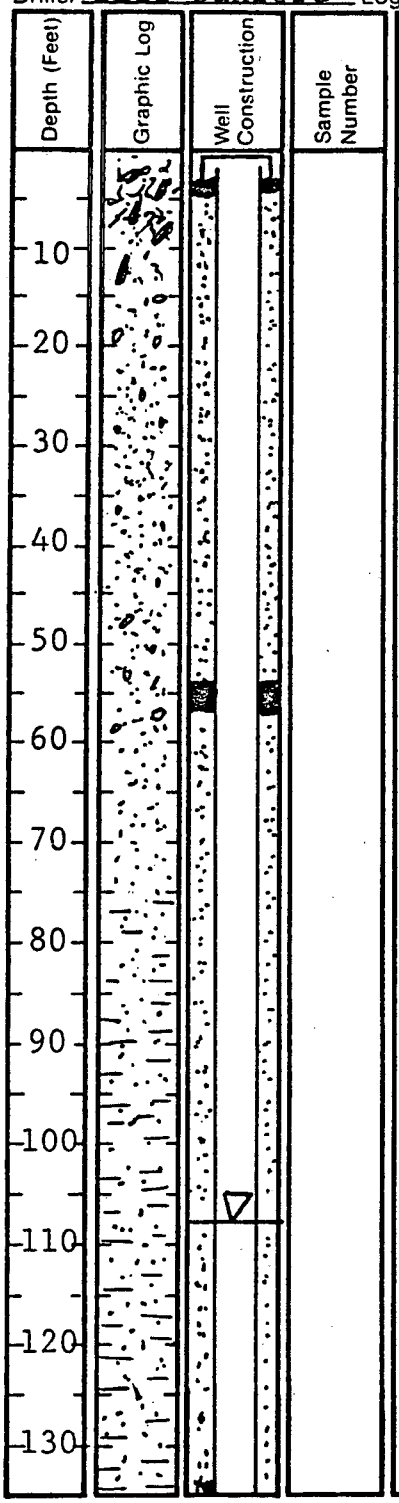
Drilling Company Layne-NY Drilling Method holl.stem auger

Driller Bill Sanford Log By C. Werle Date Drilled 10/20/82

Sketch Map



Notes Bentonite seal (20 lbs.) at about 55'



Description/Soil Classification (Color, Texture, Structures)
Black, discolored sand and gravel with refuse to 8 ft.
Dark brown medium to coarse quartz sand and gravel with some cobbles.
Same as above.
Same as above.
Dark gray medium to fine sand, well-sorted with interstitial clay, chemical odor, sample moldable.
Gray fine sand with interstitial clay, micaceous.

Environmental Resources Management

Drilling Log

Project _____ Owner _____

Location _____ W.O. Number _____

Well Number SY-4 Total Depth _____ Diameter _____

Surface Elevation _____ Water Level: Initial _____ 24-hrs. _____

Screen: Dia. _____ Length _____ Slot Size _____

Casing: Dia. _____ Length _____ Type _____

Drilling Company _____ Drilling Method _____

Driller _____ Log By _____ Date Drilled _____

Sketch Map

Notes

Depth (Feet)	Graphic Log	Well Construction	Sample Number	Description/Soil Classification (Color, Texture, Structures)
140				(continued)
150				Same as above with interbedded light gray laminated clay stringers.
160				

Environmental Resources Management

Drilling Log

Project NYSDOH Landfill Invest Owner

Location Syosset Landfill (N10049) W.O. Number

Well Number SY-5 Total Depth 135 ft. Diameter 8 in.

Surface Elevation 178.01 Water Level: Initial DTW 92 ft. 24-hrs. 87.01(elev.)

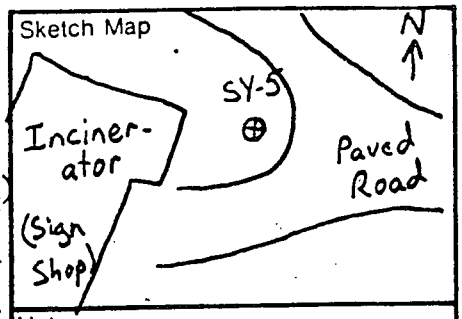
Screen: Dia. 2 in. Length 10 ft. Slot Size .02

Casing: Dia. 2 in. Length 125 ft. Type steel

Drilling Company Layne-NY Drilling Method holl.stem auger

Driller Bill Sanford Log By C. Werle Date Drilled 10/20/82

Sketch Map



Notes Bentonite seal (20 lbs.) at approx.45'

Depth (Feet)	Graphic Log	Well Construction	Sample Number	Description/Soil Classification (Color, Texture, Structures)
0				Refuse and fill to 10 feet.
10				Tan-orange medium to coarse sand with gravel and small cobbles.
20				
30				Same as above.
40				
50				Same as above.
60				
70				Tannish gray well sorted medium sand with muscovite flakes, minor interstitial clay.
80				
90				
100				Gray fine to medium sand, micaceous interstitial clay content higher than above, sample moldable.
110				
120				Same as above with no major clay units encountered.
130				

Environmental Resources Management

Drilling Log

Project NYSDOH Landfill Invest Owner

Location Syosset Landfill W.O. Number

Well Number SY-6 (N10050) Total Depth 145 ft. Diameter 8 in.

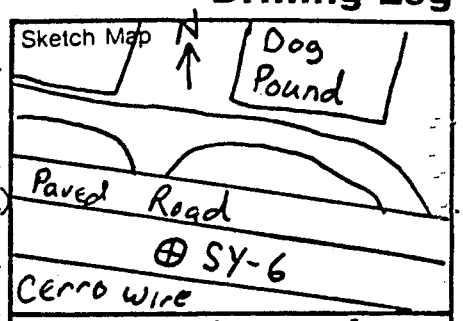
Surface Elevation 185.84' Water Level: DTW Initial 98 ft. 24-hrs. 87.80 (elev.)

Screen: Dia. 2 in. Length 10 ft. Slot Size .02

Casing: Dia. 2 in. Length 135 ft. Type steel

Drilling Company Layne-NY Drilling Method holl. stem auger

Driller Bill Sanford Log By C. Werle Date Drilled 10/19/82



Notes Bentonite seal (20 lbs.) at 28'.

Depth (Feet)	Graphic Log	Well Construction	Sample Number	Description/Soil Classification (Color, Texture, Structures)
10				Unsorted medium to coarse organce brown sand with gravel and cobbles, subangular to subround.
20				
30				Same as above with cobbles (1" to 2").
40				
50				
60				Driller indicates materials change.
70				
80				Light yellowish tan medium to fine sand minor fine gravel, micaceous.
90				
100				
110				
120				Yellowish tan fine to medium sand with interstitial silt and clay, micaceous, sample somewhat cohesive and moldable.
130				

Environmental Resources Management

Drilling Log

Project _____ Owner _____

Location _____ W.O. Number _____

Well Number SY-6 Total Depth _____ Diameter _____

Surface Elevation _____ Water Level: Initial _____ 24-hrs. _____

Screen: Dia. _____ Length _____ Slot Size _____

Casing: Dia. _____ Length _____ Type _____

Drilling Company _____ Drilling Method _____

Driller _____ Log By _____ Date Drilled _____

Sketch Map

Notes

Depth (Feet)	Graphic Log	Well Construction	Sample Number	Description/Soil Classification (Color, Texture, Structures)
140				(continued)
150				Sharp contact with dense cohesive plastic gray sandy clay.

Environmental Resources Management

Drilling Log

Project NYSDOH Landfill Invest Owner

Location Syosset Landfill W.O. Number

Well Number SY-7 (N10051) Total Depth 145 ft. Diameter 8 in.

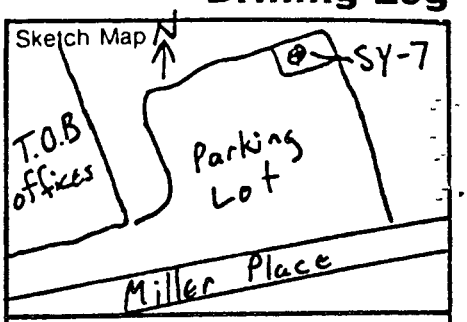
Surface Elevation 199.43' Water Level: Initial 24-hrs 86.80 (elev)

Screen: Dia. 2 in. Length 10 ft. Slot Size .02

Casing: Dia. 2 in. Length 135 ft. Type steel

Drilling Company Layne-NY Drilling Method holl. stem auger

Driller Bill Sanford Log By C. Werle Date Drilled 10/21/82



Notes: Bentonite seal (20 lbs.) at about 50'

Depth (Feet)	Graphic Log	Well Construction	Sample Number	Description/Soil Classification (Color, Texture, Structures)
10				Medium to coarse yellowish tan quartz sand with gravel and small cobbles subangular to subround.
20				
30				
40				Same as above.
50				
60				Same as above.
70				
80				
90				Yellow tan well sorted fine sand, some interstitial clay, micaceous, trace gravel.
100				
110				
120				Same as above.
130				

Environmental Resources Management

Drilling Log

Project _____ Owner _____

Location _____ W.O. Number _____

Well Number SY-7 Total Depth _____ Diameter _____

Surface Elevation _____ Water Level: Initial _____ 24-hrs. _____

Screen: Dia. _____ Length _____ Slot Size _____

Casing: Dia. _____ Length _____ Type _____

Drilling Company _____ Drilling Method _____

Driller _____ Log By _____ Date Drilled _____

Sketch Map

Notes

Depth (Feet)	Graphic Log	Well Construction	Sample Number	Description/Soil Classification (Color, Texture, Structures)
140				(continued) Light gray laminated plastic clay stringers 0.5 to 2 feet thick interbedded with tan orange medium to fine micaceous sand.
150				

Environmental Resources Management

Drilling Log

Project NYSDOH Landfill Inv. Owner NCDH

Location Denton Ave. L.F. North Site W.O. Number

Well Number DA-1 Total Depth 120 ft. Diameter 8 in.

Surface Elevation 108.62 Water Level: Initial DTW 70.10' 24-hrs. 39.19

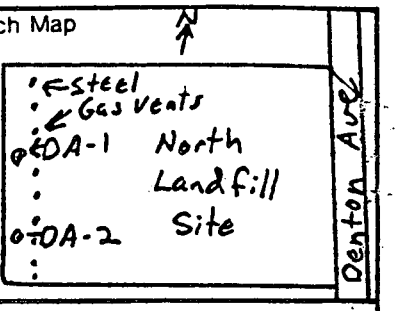
Screen: Dia. 2 in. Length 10 ft. Slot Size .02

Casing: Dia. 2 in. Length 110 ft. Type steel

Drilling Company Layne-NY Drilling Method holl.stem auger

Driller Log By Date Drilled

Sketch Map



Notes Bentonite seal (20 lbs.) at about 50'

Depth (Feet)	Graphic Log	Well Construction	Sample Number	Description/Soil Classification (Color, Texture, Structures)
0–10				Dark grayish brown medium to fine sand with soft, mixed household refuse.
10–20				Discolored black coarse to fine sand with refuse, strong odor, constant to 35'.
20–30				
30–40				Discolored brownish gray medium to fine sand with some gravel - odorous and warm.
40–50				
50–60				Same as above.
60–70				
70–80				Discolored, odorous, brownish-gray medium to coarse sand with gravel and some small cobbles.
80–90				
90–100				
100–110				Materials change indicated by driller.
110–120				Light brownish gray fine sand with medium sand and mica interstitial silt and clay - odor less than above.

Environmental Resources Management

Drilling Log

Project NYSDOH Landfill Inv. Owner NCDH

Location Denton Ave. L.F. W.O. Number

Well Number DA-2 Total Depth 95 ft. Diameter 8 in.

Surface Elevation 109.92 Water Level: Initial DTW 70.2' 24-hrs. 41.10

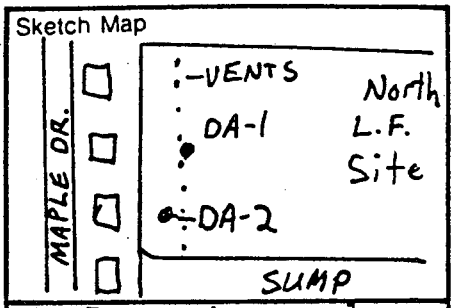
Screen: Dia. 2 in. Length 10 ft. Slot Size .02

Casing: Dia. 2 in. Length 85 ft. Type steel

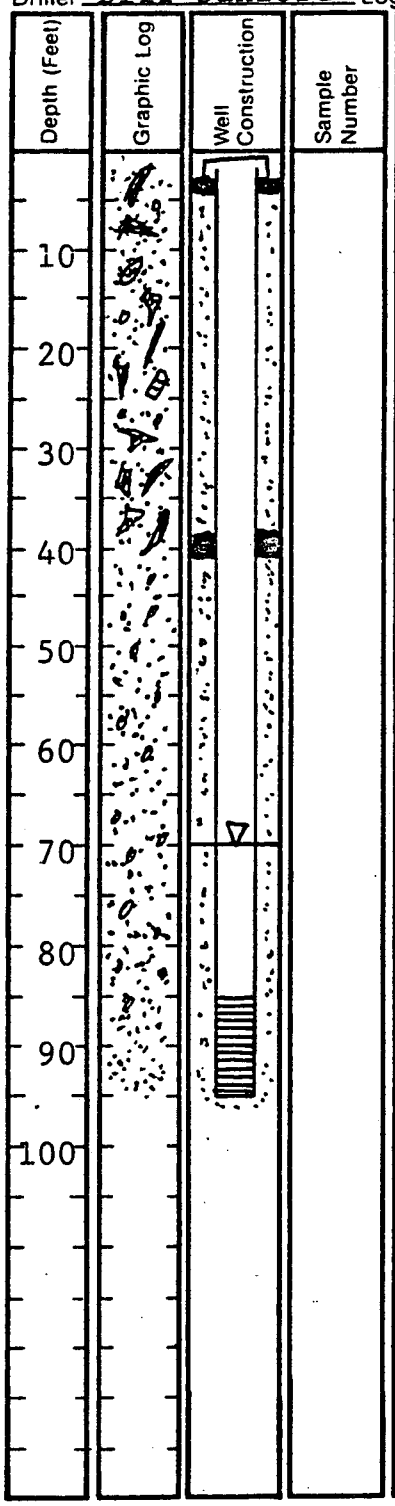
Drilling Company Layne-NY Drilling Method holl.stem auger

Driller Bill Sanford Log By C. Werle Date Drilled 11/11/82

Sketch Map



Notes Bentonite seal (20 lbs) at about 40'.



Description/Soil Classification (Color, Texture, Structures)
Dark grayish black fine to coarse sand and gravel with refuse, to 40 ft.
Same as above.
Discolored brownish gray medium to coarse sand and gravel, some fine sand, strong odor.
Brownish gray medium to coarse sand and gravel, strong odor.
Grayish black medium to fine sand with some coarse sand.

Environmental Resources Management

Drilling Log

Project NYSDOH Landfill Inv. Owner NCDH

Location Wm. Bowie School W.O. Number

Well Number DA-3 Total Depth 100 ft. Diameter 8 in.

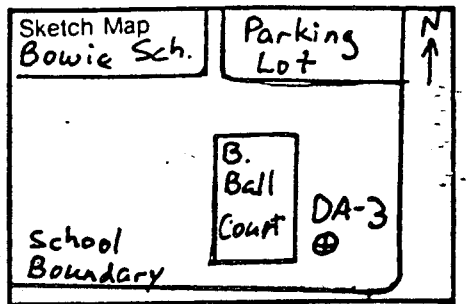
Surface Elevation 121.50 Water Level: Initial DTW 81.39 24-hrs. 40.46

Screen: Dia. 2 in. Length 10 ft. Slot Size .02

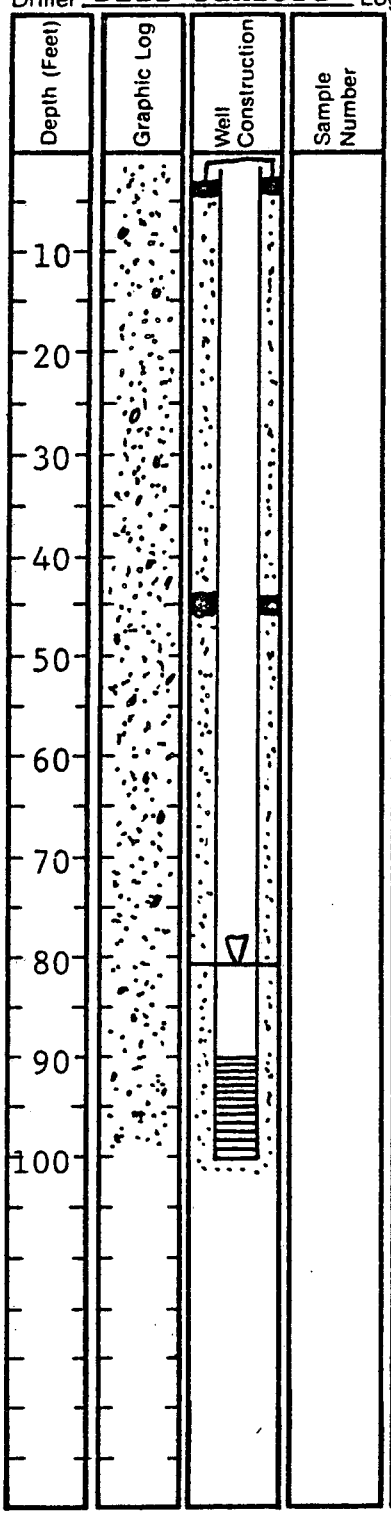
Casing: Dia. 1 in. Length 90 ft. Type steel

Drilling Company Layne-NY Drilling Method holl. stem auger

Driller Bill Sanford Log By C. Werle Date Drilled 11/11/82



Notes Bentonite seal (20 lbs.) at about 45'



Description/Soil Classification (Color, Texture, Structures)
Orange brown fine to medium sand with coarse sand and gravel.
Tan brown medium to coarse sand and gravel, some fine sand.
Same as above.
Same as above.
Same as above.

Environmental Resources Management

Drilling Log

Project NYSDOH Landfill Inv. Owner NCDH

Location Denton Ave. L.F. South Site W.O. Number

Well Number DA-4 Total Depth 95 ft. Diameter 8 in.

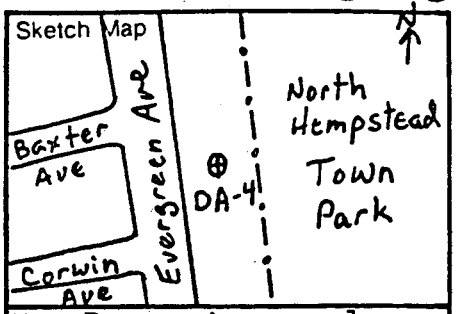
Surface Elevation 108.97 Water Level: Initial DTW 68.26' 24-hrs. 40.74

Screen: Dia. 2 in. Length 10 ft. Slot Size .02

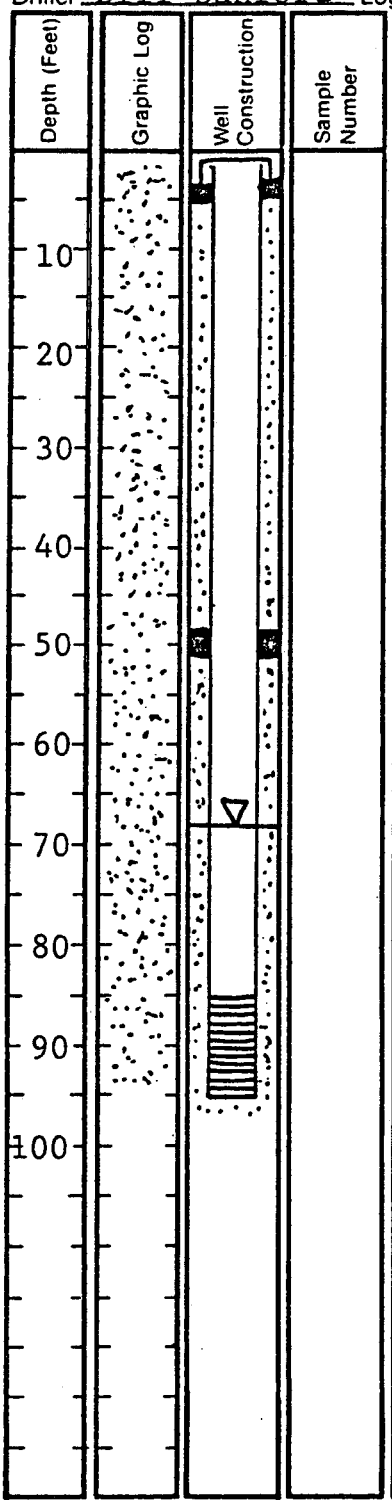
Casing: Dia. 2 in. Length 85 ft. Type steel

Drilling Company Layne-NY Drilling Method holl. stem auger

Driller Bill Sanford Log By C. Werle Date Drilled 11/12/82



Notes Bentonite seal (20 lbs.) at about 50'.



Description/Soil Classification (Color, Texture, Structures)
Tan brown medium to coarse quartz sand and gravel, some fine sand, subangular to subround.
Same as above.
Same as above.
Same as above.

Environmental Resources Management

Drilling Log

Project NYSDOH Landfill Inv. Owner NCDH

Location Denton Ave. L.F. South Site W.O. Number

Well Number DA-5 Total Depth 114 ft. Diameter 8 in.

Surface Elevation 109.67 Water Level: Initial DTW 69.67 24-hrs. 40.44

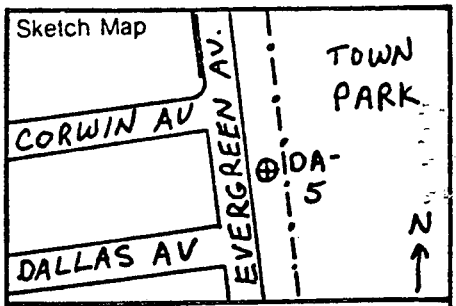
Screen: Dia. 2 in. Length 10 ft. Slot Size .02

Casing: Dia. 2 in. Length 104 ft. Type steel

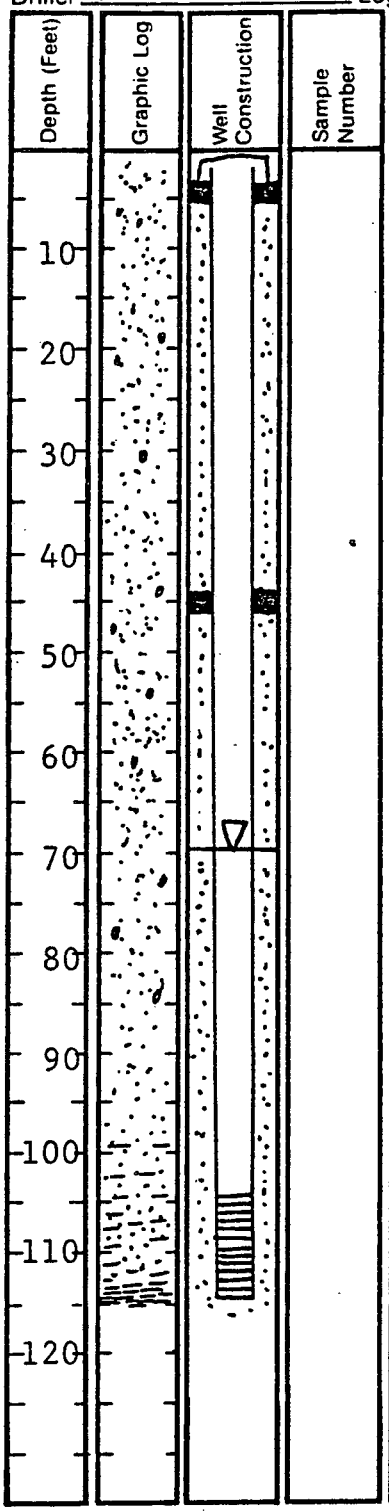
Drilling Company Layne-NY Drilling Method holl.stem auger

Driller Bill Sanford Log By C. Werle Date Drilled 11/12/82

Sketch Map



Notes Bentonite seal (20 lbs.) at about 45'

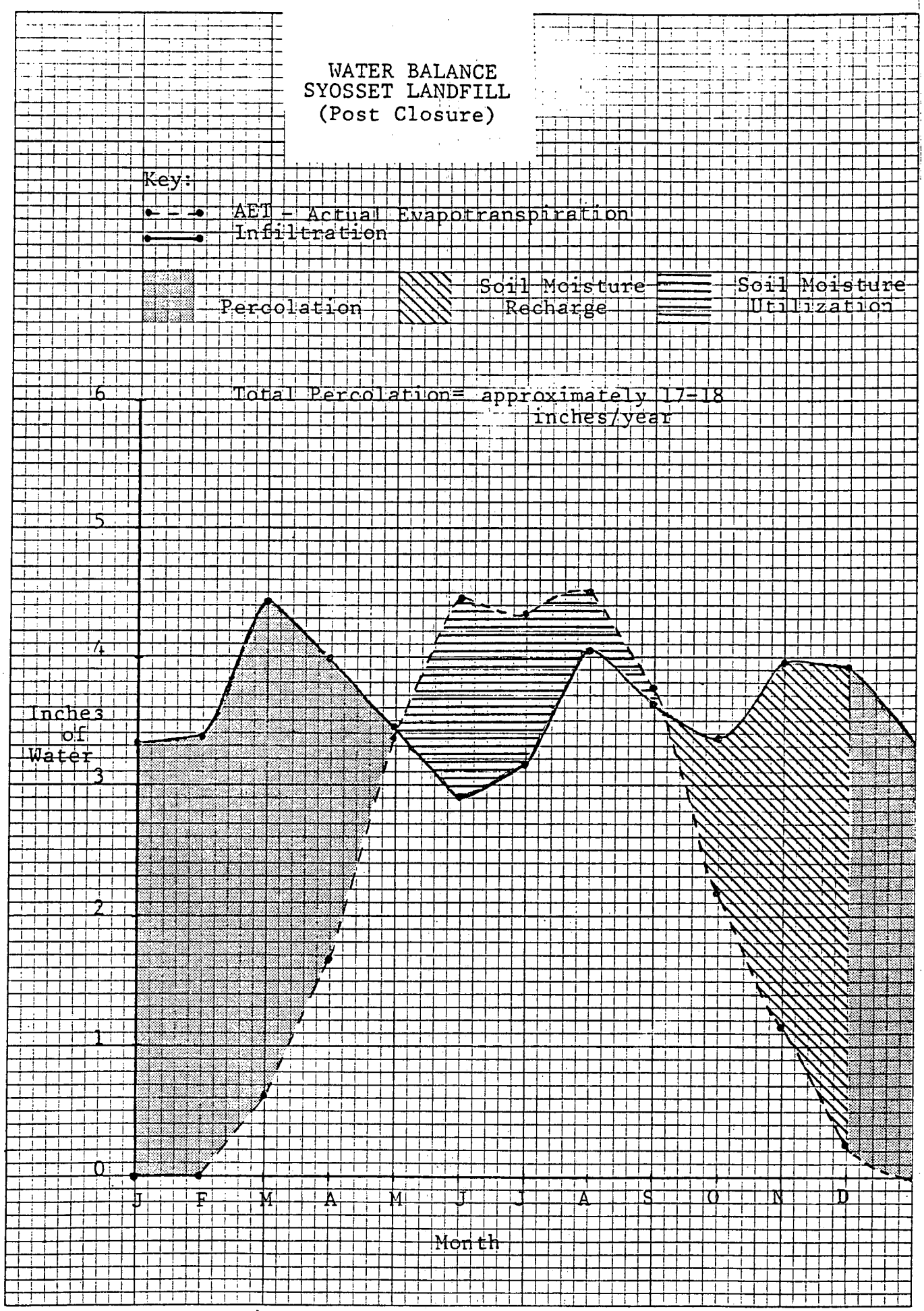


Description/Soil Classification (Color, Texture, Structures)
Tan-brown medium to coarse quartz sand with fine to coarse gravel, some fine sand, sub-angular to subround.
Same as above.
Same as above.
Driller indicates materials change yellow-tan fine to medium sand with mica and interstitial clay.
One foot seam of light tan-brown silty micaceous clay - cohesive, plastic, dense, laminated.

APPENDIX B

WATER BALANCE CALCULATIONS

SYOSSET LANDFILL



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WATER BALANCE
SYOSSET LANDFILL
(Post Closure)

Months of the year

See Table 1A	J	F	M	A	M	J	J	A	S	O	N	D	ANNUAL
PET (Adjusted)	0	0	0.62	1.67	3.36	4.84	5.63	5.72	4.25	2.18	1.15	0.25	29.67
P	3.31	3.37	4.44	4.01	3.46	2.93	3.17	4.06	3.63	3.38	3.97	3.92	43.65
R/O (1)	0	0	0	0	0	0	0	0	0	0	0	0	0
I (P-R/O)	3.31	3.37	4.44	4.01	3.46	2.93	3.17	4.06	3.63	3.38	3.97	3.92	43.65
I-PET	3.31	3.37	3.82	2.34	0.10	-1.91	-2.46	-1.66	-0.62	1.20	2.82	3.67	-
Σ Neg. I-PET						-1.91	-4.37	-6.03	-6.65				-
ST	4	4	4	4	4	2.45	1.30	0.85	0.73	1.93	4	4	35.26
Δ ST	0	0	0	0	0	-1.55	-1.15	-0.45	-0.12	+1.20	+2.07	0	0
AET	0	0	0.62	1.67	3.36	4.48	4.32	4.51	3.75	2.18	1.15	0.25	26.29
Perc (2)	3.31	3.37	3.82	2.34	0.10	0	0	0	0	0	0.75	3.67	17.36

(1) No Runoff
(2) Perc= (P-R/O) - Δ ST-AET

See Table 1A for explanation of abbreviations.

Table 1A
Explanation of abbreviations used
in water balance

PET -- Potential Evapotranspiration
P -- Precipitation
R/O -- Runoff
I -- Infiltration = Precipitation - Runoff
ST -- Soil Moisture Storage
AET -- Actual Evapotranspiration
Perc -- Percolation (leachate)

APPENDIX C

WATER BALANCE CALCULATIONS

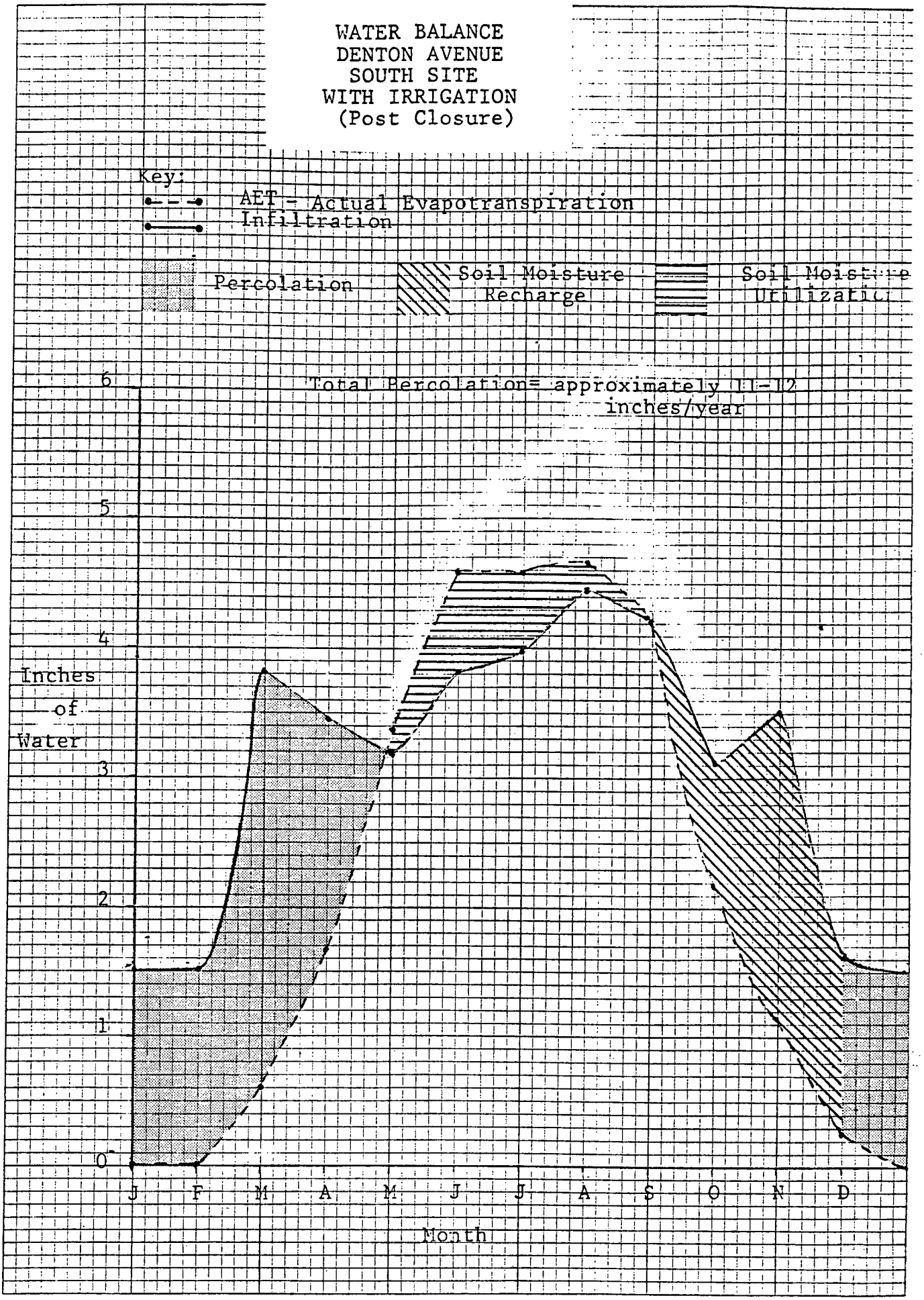
DENTON AVENUE LANDFILL

WATER BALANCE
DENTON AVENUE
SOUTH SITE
(Post Closure)

Months of the year

See Table 1A	J	F	M	A	M	J	J	A	S	O	N	D	ANNUAL
PET (Adjusted)	0	0	0.62	1.67	3.36	4.84	5.63	5.72	4.25	2.18	1.15	0.25	29.67
P (2)	3.31	3.37	4.44	4.01	3.46	4.42	4.70	5.59	5.12	3.38	3.97	3.92	49.69
R/O (3)	1.78	1.83	0.61	0.45	0.27	0.60	0.72	1.14	0.91	0.24	0.43	2.30	11.28
I (P-R/O)	1.53	1.54	3.83	3.56	3.19	3.82	3.98	4.45	4.21	3.14	3.54	1.62	38.41
I-PET	1.53	1.54	3.21	1.89	-0.17	-1.02	-1.65	-1.27	-0.04	0.96	2.39	1.37	-
Σ Neg. I-PET					-0.17	-1.19	-2.84	-4.11	-4.15				-
ST	2	2	2	2	1.83	1.05	0.44	0.23	0.22	1.18	2	2	16.95
Δ ST	0	0	0	0	-0.17	-0.78	-0.61	-0.21	-0.01	+0.96	+0.82	0	0
AET	0	0	0.62	1.67	3.36	4.60	4,59	4.66	4.22	2.18	1.15	0.25	27.05
Perc (4)	1.53	1.54	3.21	1.89	0	0	0	0	0	0	1.57	1.37	11.11

(1) See Table 1A for explanation
(2) Sum of P and irrigation for months of June, July, August and September
(3) Runoff calculated by Soil Conservation Service Method
(4) Perc= (P-R/O) - Δ ST - AET



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WATER BALANCE
DENTON AVENUE
NORTH SITE
(Post Closure)

Months of the year

	J	F	M	A	M	J	J	A	S	O	N	D	ANNUAL
PET Adjusted)	0	0	0.62	1.67	3.36	4.84	5.63	5.72	4.25	2.18	1.15	0.25	29.67
P	3.31	3.37	4.44	4.01	3.46	2.93	3.17	4.06	3.63	3.38	3.97	3.92	43.65
R/O (1)	1.30	1.30	1.70	1.40	1.50	0.72	0.85	1.40	1.10	0.98	1.40	1.70	15.35
I (P-R/O)	2.01	2.07	2.74	2.61	1.96	2.21	2.32	2.66	2.53	2.40	2.57	2.22	28.30
-PET	2.01	2.07	2.12	0.94	-1.40	-2.63	-3.31	-3.06	-1.72	0.22	1.42	1.97	-
Σ Neg. -PET					-1.40	-4.03	-7.34	-10.40	-12.12				-
ST	10	10	10	10	8.72	6.72	4.81	3.55	2.99	3.21	4.63	6.60	81.23
Δ ST	0	0	0	0	-1.28	-2.00	-1.91	-1.26	-0.56	+0.22	+1.42	+1.97	-3.40
AET	0	0	0.62	1.67	3.24	4.21	4.23	3.92	3.09	2.18	1.15	0.25	24.56
(2) Perc	2.01	2.07	2.12	0.94	0	0	0	0	0	0	0	0	7.14

(1) Runoff calculated by Soil Conservation Service Method
(2) Perc= (P-R/O) - Δ ST - AET

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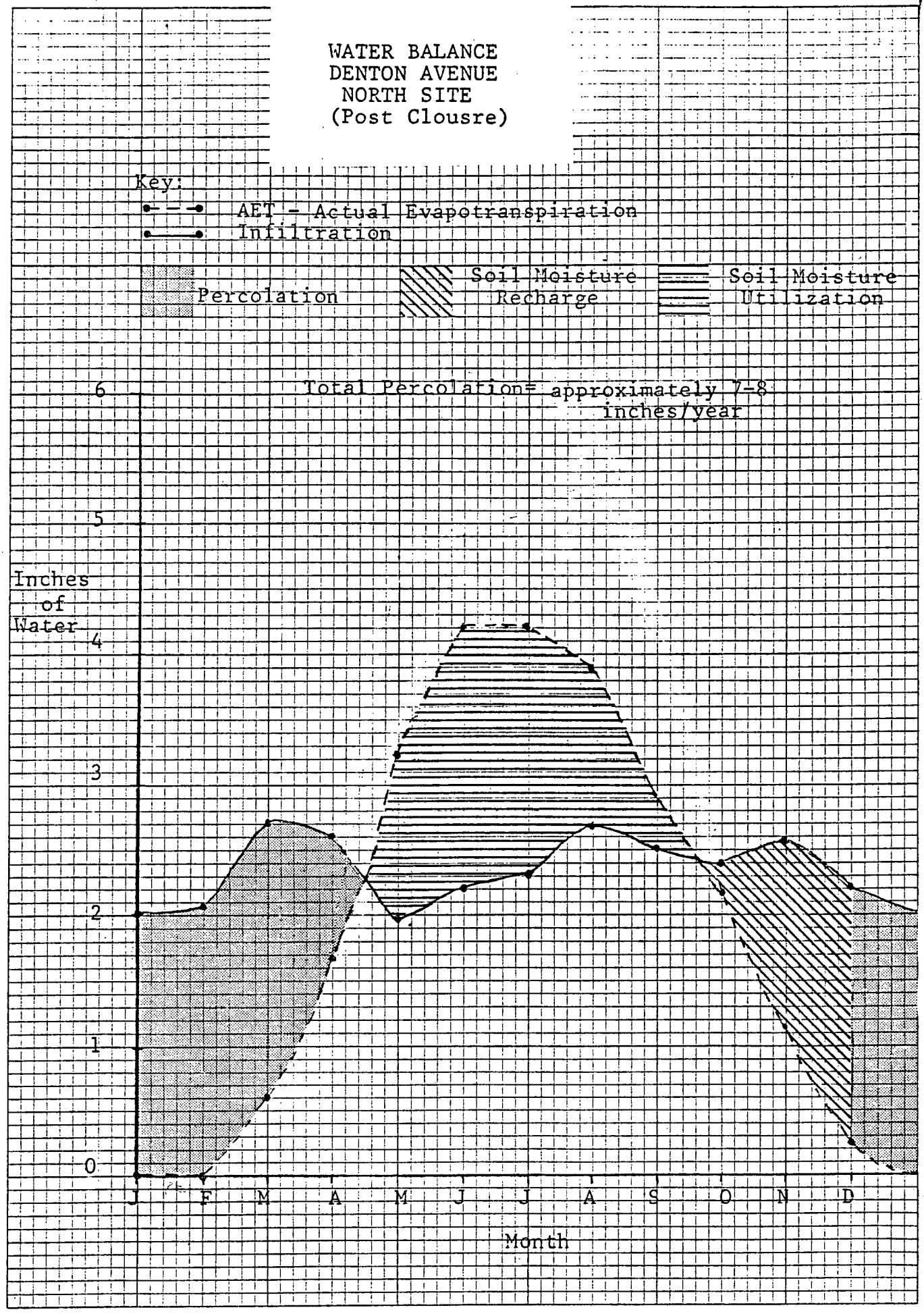
WATER BALANCE
DENTON AVENUE
NORTH SITE
(Post Clousre)



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